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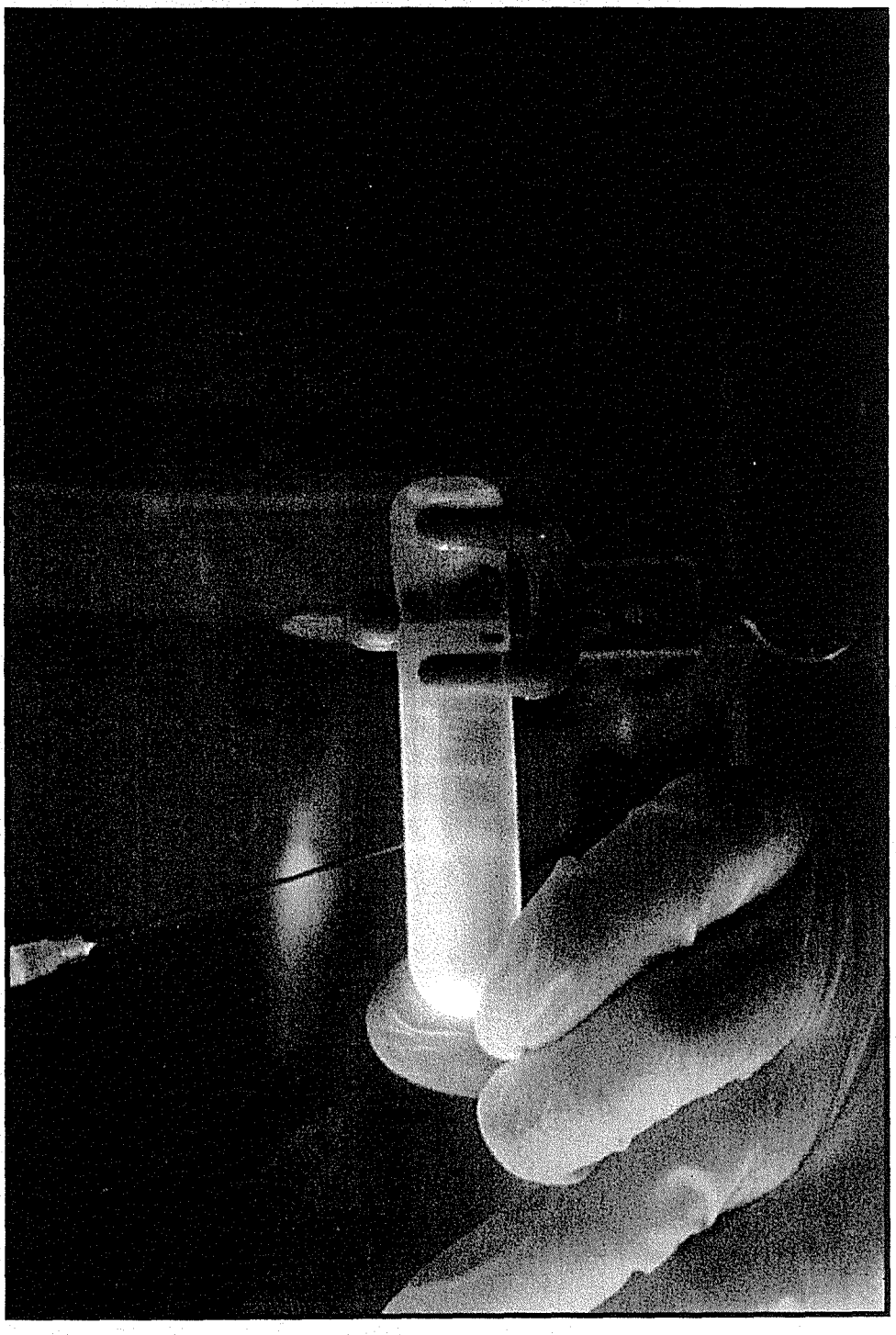
TEACHER RESOURCE BOOK

DYNAMIC SCIENCE

BOOK 4



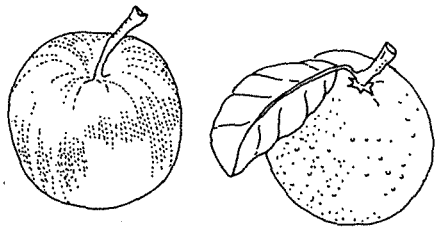
D. WILSON • M. BAUER

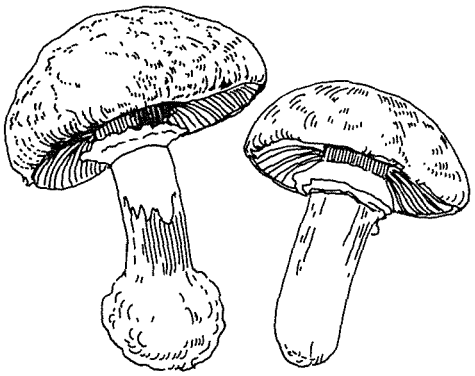
Food survey form

Date	*Meal* (B, L, D, S)	*Food eaten*	*Approximate amount* (grams, cups etc)	*Approximate energy content* (kJ)	*Food group/s present*	*Was it preserved? If so, how?*	*Extra information*
Notes		B = breakfast L = lunch D = dinner S = snack		Use BLM 2 to help			

Joule counter

	Amount	*Kilojoules*
Drinks		
tea/coffee	black, 1 cup	0
tea/coffee	white, 1 cup	124
tea/coffee	white, 1 cup, 2 tspn sugar	290
hot chocolate	200 mL	663
milk, plain	200 mL	551
milk, flavoured	300 mL	994
thick shake	1 cup	1139
skim milk	200 mL	290
mineral water	1 glass	0
fruit juice, unsweetened	120 mL	248
beer	284 mL (middy)	497
wine, sweet	120mL	393
Convenience foods		
chicken with chips	1 piece chicken	1864
pizza	1/8 medium (215 g slice)	1097
fish and chips	1 piece fish	1656
meat pie	1 pie	2071
hamburger	120 g meat	1781
Fruit		
apple	100 g	222
banana	100 g	364
mandarine	1 small	94
orange	130 g	245
pear	150 g	348
dried fruit	1½ tbspn	290
Carbohydrate foods		
bread	1 slice	290
dry breakfast food (cereal)	30 g	455
uncooked pasta and rice	2 tbspn	455
Protein foods		
cheese, hard	30 g	497
cottage cheese	30 g	435
eggs, boiled	1 × 50 g	331
fish, raw	150 g	621
chicken, raw	150 g	897
meat, beef, raw	150 g	952
meat, pork, raw	150 g	1077
bacon, grilled	40 g	415
Fats and oils (*Note:* Figures are the same for polyunsaturated varieties)		
butter, margarine	1 tspn	112
cream	1 tbspn	302
mayonnaise	1 tbspn	559
oil	1 tbspn	696
Vegetables		
broccoli, boiled	60 g	66
carrots, raw	60 g	90
celery, raw	30 g	21
lettuce	30 g	17
mushrooms, raw	60 g	54
onions, raw	60 g	90
potatoes, boiled	90 g	300
potatoes, fried	90 g	1000
peas, boiled	60 g	290
Sweets		
biscuits, chocolate-coated	1 biscuit	415
cake, cream	80 g slice	1150
doughnut, plain	1 whole	1140
ice cream	1 scoop	475
sugar	10 g (2 tspn)	165
honey	30 g	350

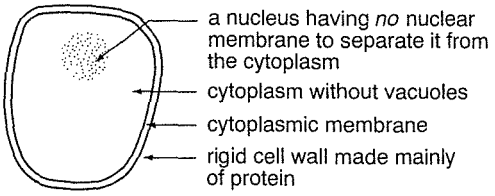




What are bacteria like?

Part A: Typical bacteria

Bacteria are simple organisms that are all around us. Some bacteria are useful, while other bacteria cause disease. For example, bacteria are used in bread-making and wine-making.



A bacterium

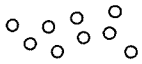
Note: Bacteria may also have other features present, such as:
- chlorophyll;
- slime capsules covering the cell wall; or
- flagella or thin thread-like tails of protein that enable bacteria to move.

Answer the following questions in your notebook.

1. In what way/s may a bacterium be:
   (a) similar to (i) a plant cell?
   (ii) an animal cell?
   (b) different to (i) a plant cell?
   (ii) an animal cell?
2. In what way/s may a bacterium differ from both plant and animal cells?

Part B: Naming different types of bacteria

There are three main types of bacterial cells:
(a) spherical or **cocci** cells (b) rod-like or **bacilli** cells (c) spiral or **spirilla** cells


cocci


bacilli

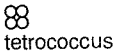

spirilla

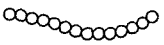
Bacteria may group themselves in twos (diplo), fours (tetro), clusters that look like grapes (staphylo), or in strips (strepto).

The grouping of the cells provides the beginning of the name, while the shape of cell provides the ending for the name. Some examples are:

- bacteria having two rod-like cells would be called diplobacilli;
- bacteria having four spherical cells would be called tetrococci;
- bacteria having strips of spherical cells would be called streptococci.


diplobacillus


tetrococcus


streptococcus

Answer the following questions in your notebook.

3. Use the information given previously to draw the following bacteria: diplococcus, staphylococcus, streptobacillus.
4. What would be the name of a bacterium that had four rod-like cells?

Research

1. (a) Find out the names of at least three diseases or illnesses caused by bacteria.
   (b) How is each of these diseases or illnesses spread?
2. Viruses are different to bacteria. Investigate the differences.

Breakfast, the most important meal of the day?

The table provides nutritional information for four breakfast foods—mueslis A, B and C, and a wheat cereal.

	Muesli A			*Muesli B*			*Muesli C*			*Wheat cereal*		
	per 45 g serve	*per 100 g*	*per 45 g with ½ cup skim milk*	*per 45 g serve*	*per 100 g*	*per 45 g serve with ½ cup skim milk*	*per 30 g serve*	*per 100 g*	*per 30 g with ½ cup skim milk*	*per 30 g serve*	*per 100 g*	*per 30 g serve with ½ cup whole milk*
Energy	626 kJ	1390 kJ	807 kJ	586 kJ	1300 kJ	767 kJ	460 kJ	1534 kJ	641 kJ	420 kJ	1380 kJ	750 kJ
Protein	3.4 g	7.6 g	7.8 g	3.6 g	8.1 g	8.0 g	2.7 g	8.9 g	7.2g	3.3 g	11.0 g	7.8 g
Fat	1.2 g	2.6 g	1.3 g	1.1 g	2.5 g	1.2 g	0.4 g	1.4 g	0.5 g	0.8 g	2.7 g	5.5 g
Carbohydrate												
—total	32.8 g	72.9 g	39.1 g	36.0 g	79.9 g	42.3 g	25.0 g	83.2 g	31.4 g	20.0 g	66.8 g	25.7 g
—sugars	8.6 g	19.0 g	14.9 g	12.2 g	27.0 g	18.5 g	5.5 g	18.2 g	11.9 g	0.7 g	2.3 g	6.4 g
Total dietary fibre	4.1 g	9.0 g	4.1 g	5.8 g	12.9 g	5.8 g	2.8 g	9.3 g	2.8 g	3.7 g	12.2 g	3.7 g
Cholesterol	nil	nil	5 mg	nil	nil	5 mg	nil	nil	5 mg	nil	nil	18 mg
Calcium	25 mg	50 mg	175 mg	*	*	*	*	*	*	*	*	*
Sodium	100 mg	240 mg	175 mg	232 mg	515 mg	300 mg	88 mg	295 mg	158 mg	80 mg	270 mg	152 mg
Potassium	125 mg	280 mg	335 mg	248 mg	550 mg	458 mg	131 mg	437 mg	348 mg	105 mg	350 mg	298 mg
		%RDA						%RDA				
Vitamin B_1	0.82 mg	82	0.90 mg	0.41 mg	*	*	0.28 mg	84	0.34 mg	0.009 mg	*	0.06 mg
Vitamin B_2	1.20 mg	100	1.62 mg	0.60 mg	*	*	0.4 mg	81	0.6 mg	0.054 mg	*	0.25 mg
Niacin	8.25 mg	88	9.75 mg	4.13 mg	*	*	2.8 mg	84	2.8 mg	2.07 mg	*	2.17 mg
Iron	*	*	*	3.75 mg	*	*	2.5 mg	83	2.5 mg	1.65 mg	*	1.75 mg
Vitamin C	22.50 mg	80	24.50 mg	*	*	*	*	*	*	*	*	*

% RDA Recommended Daily Allowance per 45 g serve with ½ cup skim milk
* Not listed

Use the information in the table to answer the following questions, in your notebook.

1. What serving size is used for:
   (a) muesli A and B?
   (b) muesli C and wheat cereal?
2. Which cereal (per 100 g) has:
   (a) the greatest energy content?
   (b) the lowest energy content?
   (c) lowest sugar content?
   (d) highest sugar content?
3. Suggest reasons why the sugar values are different for the wheat cereal and the mueslis.
4. Which cereal has the highest dietary fibre (per 100 g)?
5. Your friend wants to eat a cereal that is high in vitamins. Which cereal/s would you suggest? Explain your answer.
6. Do you think that breakfast is the most important meal of the day? Explain your answer.

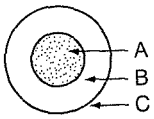
Homework
Compare and comment on the nutritional information provided on the packages of cereal that you use at home.

Activity: Advertising and breakfast foods
Spend a week or so investigating the advertising of breakfast cereals. Check magazines and television commercials. Ask questions such as are advertisers interested in promoting a healthy image, who is the target market for each cereal, and so on. Prepare a report. (You may also like to run a survey of classes in your school to decide which cereal/s is/are most popular and why.)

Mitosis: Fertilised fruit fly egg to larva

This is a simplified view.

Original cell (fertilised fruit fly egg).



1. Parts of cell: A _____
   B _____
   C _____

Cell about to divide. Chromosomes become visible.

2. (a) Number of chromosomes: _____
   (b) Does each have a matching partner?: _____

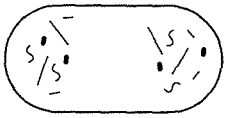
Chromosomes double.

3. Total number of chromosomes now present in cell: _____

Double chromosomes line up across middle of cell.

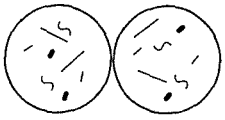
4. Number of doubles across cell: _____

Doubles separate and chromosomes go to opposite ends of cell.



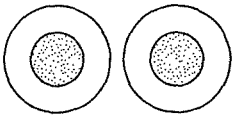
5. Number of chromosomes in each half of cell: _____

Membrane divides cell in two.



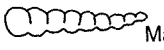
6. Number of chromosomes in each new cell: _____

Chromosomes form nuclei of new cells.



7. Are these identical with those of the original cell?: _____

Repeated cell division accompanied by differentiation results in a multicellular organism.

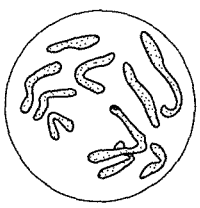


8. What can be said about the chromosomes in all the body cells of the organism?: _____
   _____

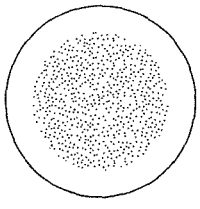
Some stages of mitosis in the cells of a growing animal

Cut these out and place them in the correct order in your notebook.

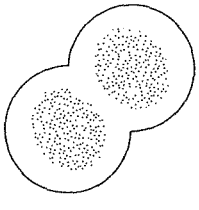
(a)



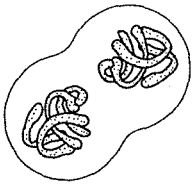
(b)



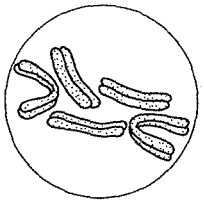
(c)



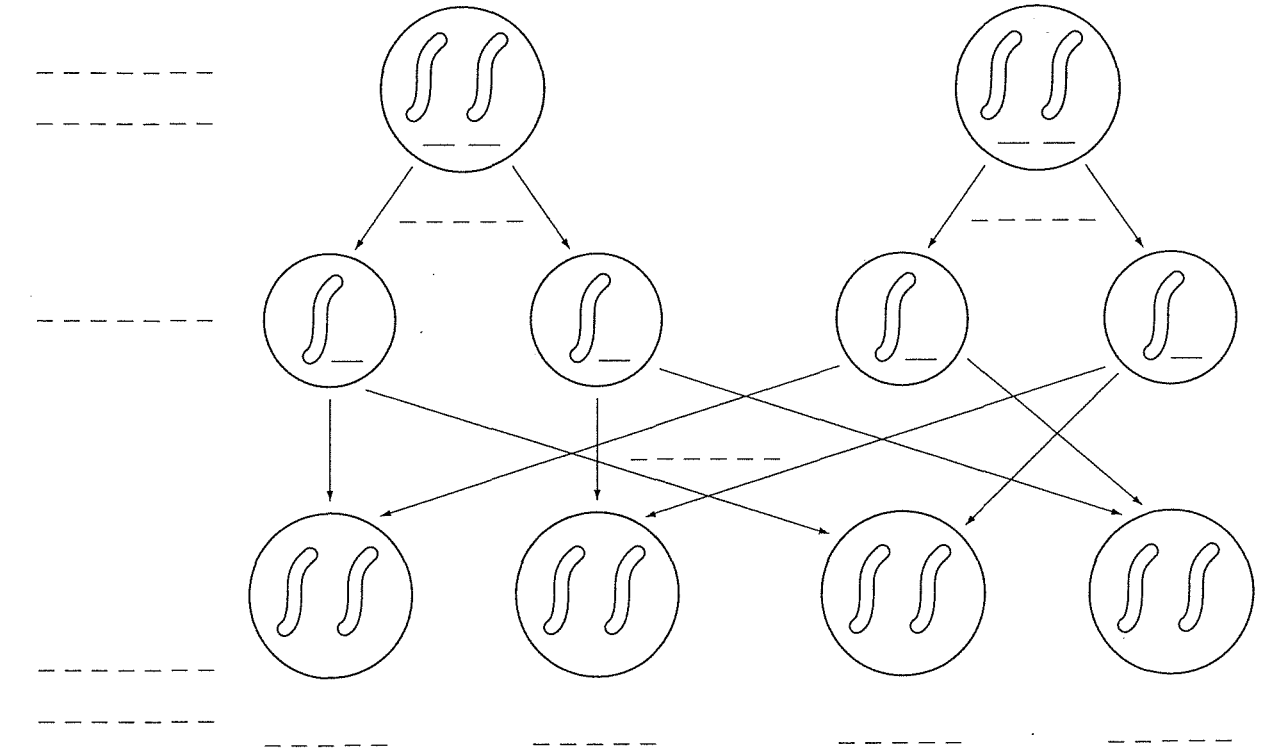
(d)

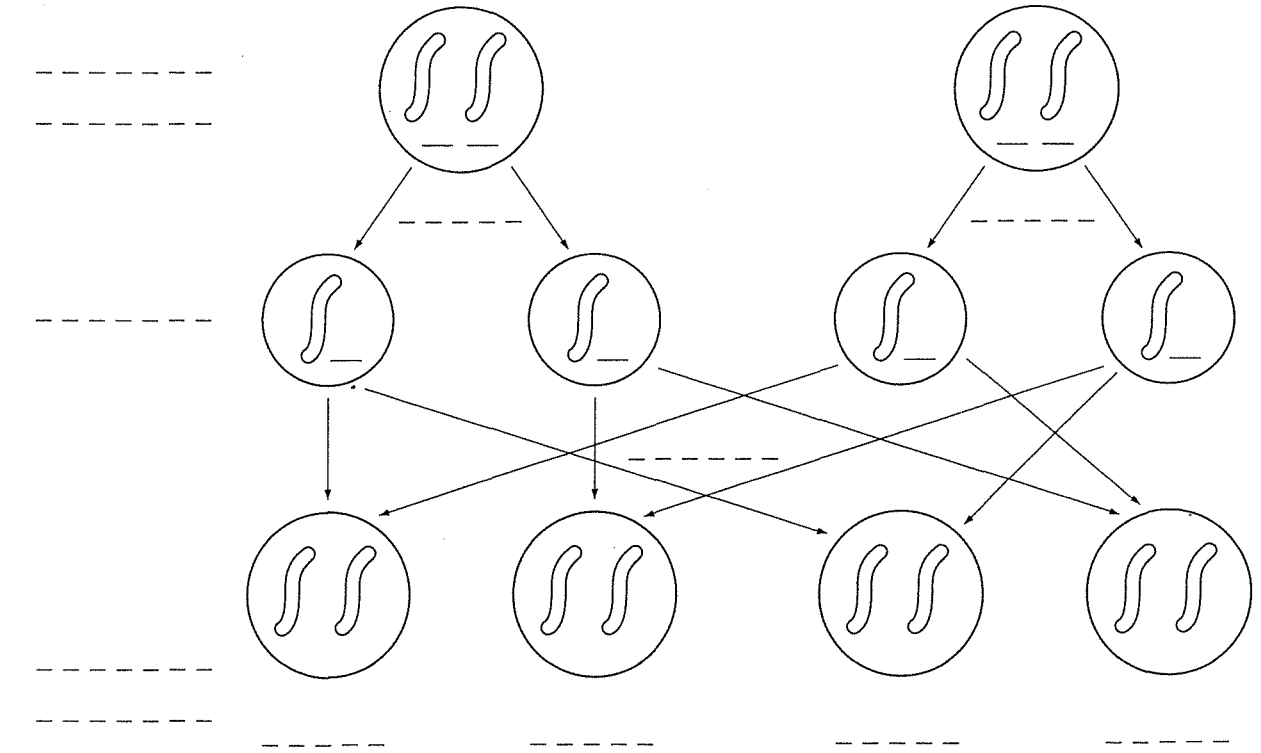


(e)



Meiosis and inheritance





Punnett puzzles

The results of some of Mendel's experiments are summarised in the table. Use these results to answer the questions in Section A.

Parent plants	Tall pea × Short pea	Pea with round seeds × Pea with wrinkled seeds	Pea wih yellow seeds × Pea with green seeds	Pea with mauve flowers × Pea with white flowers
1st generation	all tall	all round	all yellow	all mauve
2nd generation*	787 tall 277 short	5474 round 1850 wrinkled	6022 yellow 2001 green	705 mauve 224 white
ratio of types in 2nd generation	tall:short 2.8:1	round:wrinkled 3:1	yellow:green 3:1	mauve:white 3.1:1

Note: The second generation was obtained by allowing the first generation to self pollinate.

Section A

1. Which characteristic is dominant?
   (a) tall or short
   (b) round or wrinkled seed
   (c) green or yellow seed
   (d) white or mauve flower
2. In your notebook, draw Punnett squares for:
   (a) tall pea(TT) crossed with short pea(tt)
   (b) round seed(RR) crossed with wrinkled seed(rr)
   (c) two hybrid round seeds(Rr) crossed with each other
   (d) green seed(yy) crossed with yellow seed(YY)
   (e) mauve flower(MM) crossed with white flower(mm)
   (f) two hybrid mauve flowers(Mm) crossed with each other
3. (a) For each of the six Punnett squares in question 2, list the ratio of offspring.
   (b) Why is your ratio slightly different to Mendel's result in question 2(f)?

Section B

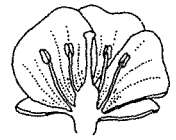
1. Imagine that a new type of pea plant has been discovered that shows intermediate inheritance (sometimes called incomplete dominance) for height. This means that tall(TT), short(XX) and middle-sized(TX) plants could occur.
   (a) Draw a Punnett square for crossing two middle-sized plants.
   (b) Give the ratio and describe the possible offspring.
2. A true-breeding short-haired female guinea pig is crossed with a true-breeding long-haired male. All the offspring of the first generation have short hair.
   (a) Which gene is dominant—the gene for short or long hair?
   (b) One of the short-haired offspring from (a) is then mated with a true-breeeding long-haired guinea pig, to produce four offspring. Use a Punnett square to work out how many of the offspring should theoretically have long hair?

Pollination

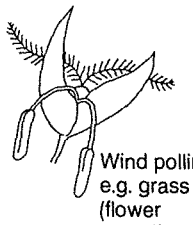
Pollination is the transfer of pollen from the anther to the stigma of a flower. Pollen grains may be carried by the wind or by insects or animals. Different flowers are adapted for pollination in different ways.

Activity: Pollination by wind or insect

Before carrying out this activity, you will need to look at the diagrams closely, and to consider how the checklist relates to the diagrams. The diagrams show two flowers, one adapted for pollination by insects and the other for pollination by the wind.



Insect pollination, e.g. apple blossom



Wind pollination, e.g. grass (flower magnified by 100X)

The checklist includes a number of characteristics that may be used to decide whether a flower is likely to be pollinated by wind or insects.

Checklist

Flowers	scented
	not scented
	nectar present
	no nectar present
Petals	brightly coloured
	green or brown colour
	landing patterns
	no landing patterns
Stamens	extend past the petals
	shorter than the petals
Stigma	feathery and large
	short and sticky

1. Construct a table to include information from the checklist together with information about the type of pollinator.
2. Once this table has been completed, ask permission to go outside and collect several flowers.
3. Observe the flowers closely.
4. Record your observations.
5. Using the table that you have constructed, classify each flower according to the method of pollination.

Did you know?

Insects are attracted to flowers of certain colours:

- yellow, blue and purple tend to attract bees,
- red attracts butterflies,
- cream and white attract moths.

Contrasting colours and patterns mark a pathway for insects to follow to the reproductive parts of the flower. Shapes of petals may also help to provide landing platforms for small insects.

Question

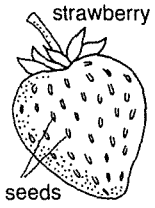
Which insect would most likely be attracted to the insect-pollinated flowers that you have observed?

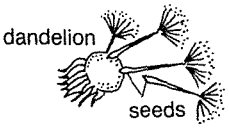
After pollination

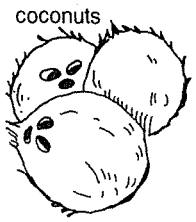
Seeds form after the flower has been pollinated. These seeds then need to be dispersed, if a new plant is to grow.

Question

Consider the following seeds, and try to work out how they may be dispersed: strawberry seeds, coconuts, grass seeds, apple seeds, peas, dandelions, macadamia nuts and waratah seeds.







Additional activity: Seed collection

Collect as many different types of seeds as possible. Decide which method each of these seeds could use for dispersal.

Useful diagrams of teeth and villi

Complete the following table.

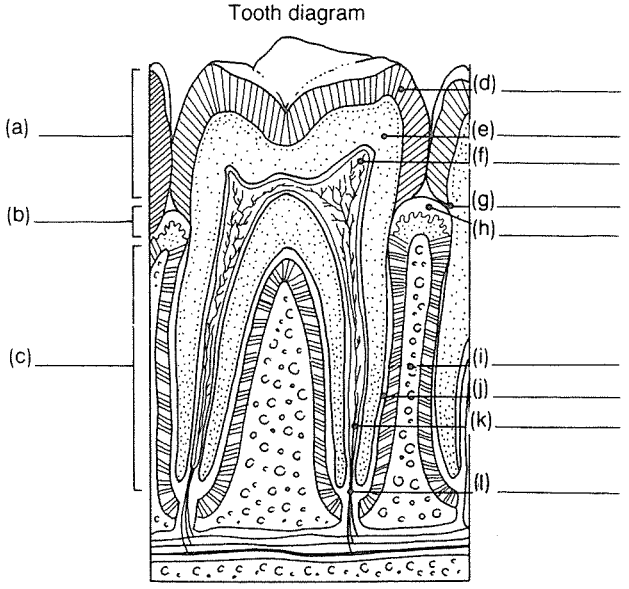
Table 2.1: Types of teeth

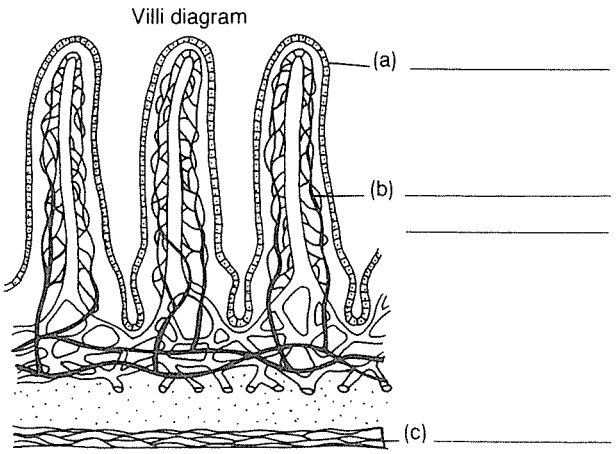
	Appearance of tooth	*Name of tooth*	*Function of tooth*
(a)		incisor	
(b)			tears food
(c)		molar	

Label the following diagrams

Tooth diagram

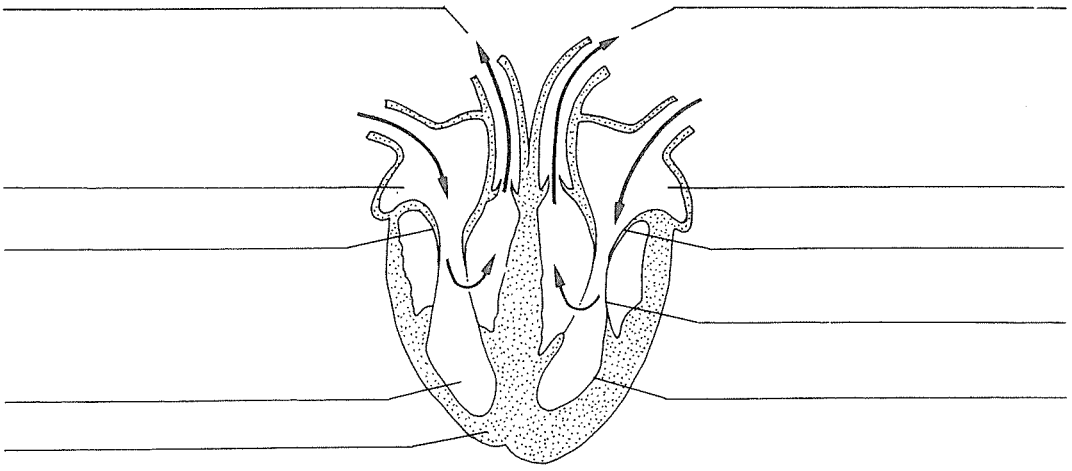
Villi diagram



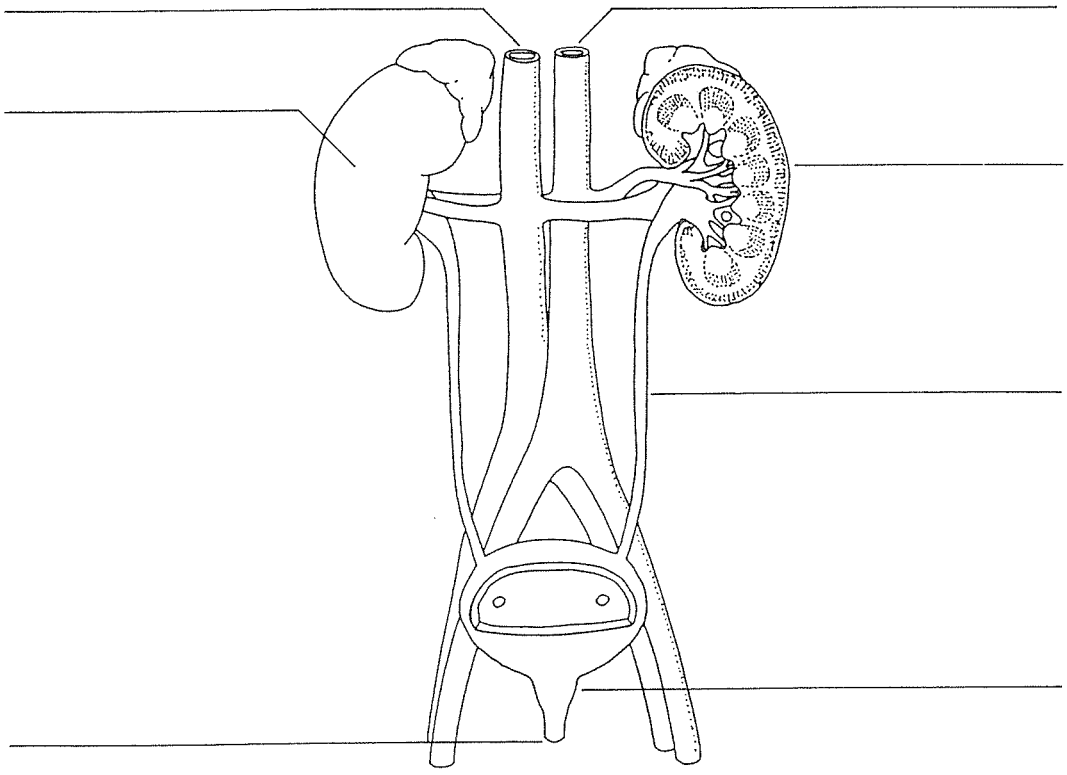


The heart and urinary system

The heart



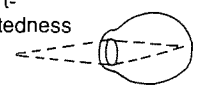
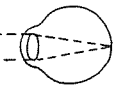
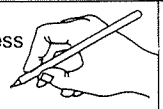
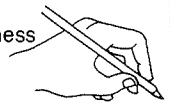
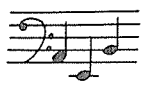
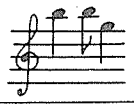
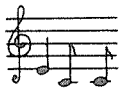
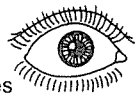
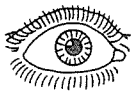
The urinary system



Genetic variations in people

The chart shows some features that are dominant and recessive in people.

DOMINANT	RECESSIVE
Curly hair 	Wavy or straight hair 
Brown hair 	Blonde hair 
Wavy hair 	Straight hair 
Grey hair at age 25 	Grey hair in old age 
Baldness (in men) 	Hair thins with age 
Hair thins with age 	Baldness (in women) 
Tongue rolled 	Tongue not rolled 
Long eyelashes 	Short eyelashes 
Narrow nose 	Wide nose 

DOMINANT	RECESSIVE
2nd toe longer than 1st 	2nd toe shorter than 1st 
Short-sightedness 	Normal sight 
Freckles 	No freckles 
Right-handedness 	Left-handedness 
Deep voice (male) 	High voice (male) 
High voice (female) 	Deep voice (female) 
Thin, flat nails 	Normal nails 
Brown eyes 	Blue eyes 
Lobe attached 	Lobe free hanging 

1. Carry out a survey in your class related to two characteristics. You could choose ability to roll the tongue, whether people have blue or non-blue eyes, whether people have free or attached earlobes, or any other suitable inherited characteristic.
   (a) Tabulate your results.
   (b) Which traits seem to be dominant and recessive in your class?

   Note: Tongue rolling may be learnt.

2. Draw up a family tree for either yourself or a friend, showing the presence or absence of at least three features. Try to include at least four people in your tree.

3. Interview an older person to investigate whether he or she believes that any special genetic characteristics are evident in his or her family. For example, the tendency to have varicose veins and the tendency to early male baldness appear to run in families.

   After the interview, decide whether you believe that any or all of the characteristics discussed, might be genetic.

   Note: If they are not genetic, they may be caused by environmental factors such as upbringing, country of birth and so on.

   Write a report on your findings.

Allergic asthma

Many young people suffer from allergic asthma. Asthma is different to hayfever. In asthma, the lungs and bronchi react to the allergen, while in hayfever, the nose and nasal passages react.

Allergic asthma may be caused by allergens, such as pollens, organic dust (e.g. pet fur), house dust (e.g. dust mites), feathers, and so on. This type of asthma may be associated with hay fever and eczema.

Allergens are often present for extended lengths of time. Since the allergens are often too small to be filtered out in the nose or pharynx, they reach the bronchi, where an allergic reaction is set up. The airways narrow and an attack occurs.

For some asthmatics, certain food additives may also cause asthma attacks. Within minutes of eating certain foods or drinking certain beverages, an asthmatic may start to wheeze.

Food additives that sometimes cause problems include tartrazine (food additive number 102) and metabisulfite (including food additive number 223).

Tartrazine is a yellow dye used to colour foods such as fruit juice, desserts, toppings, snack foods and soft drinks. Some tablets and medications also include this colouring agent.

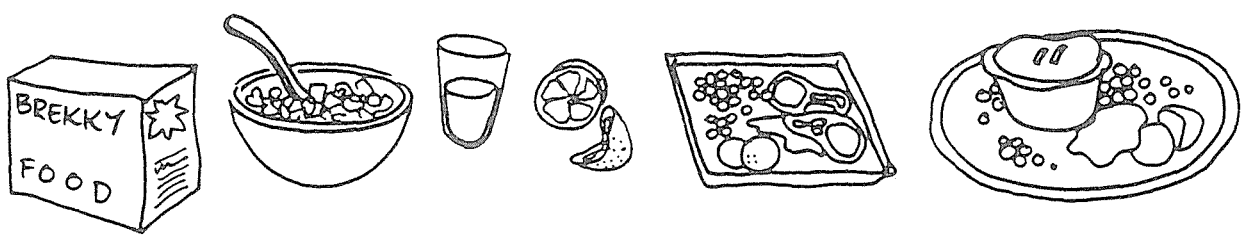
Metabisulfite is a preservative that does not occur in nature. It is added to acidic foods and drinks to stop the substances discolouring and bacteria growing. This preservative is added to foods such as dried vegetables, dried apricots, some fruit yoghurt, sausages, vinegar, wines and cordials.

Use the information together with your own ideas to answer the questions.

1. Use a dictionary to find the meaning of the word *allergen*.
2. What allergens may be found in a normal household? List two characteristics of allergens.
3. What measures do you think could be taken if the asthma sufferer knew which allergen caused his/her asthma attacks?
4. Which two food additives sometimes cause problems for asthmatics?
5. In what types of food are tartrazine and metabisulfite found?
6. What is the function of:
   (a) tartrazine, and
   (b) metabisulfite, in foods?
7. (a) What are food additive numbers?
   (b) Where are they found?
   (c) How could these numbers be useful?

Research

Another food additive that may cause problems for asthmatics is msg, monosodium glutamate. Find out the food additive number for this substance. To what types of foods is MSG added? Why is it used?

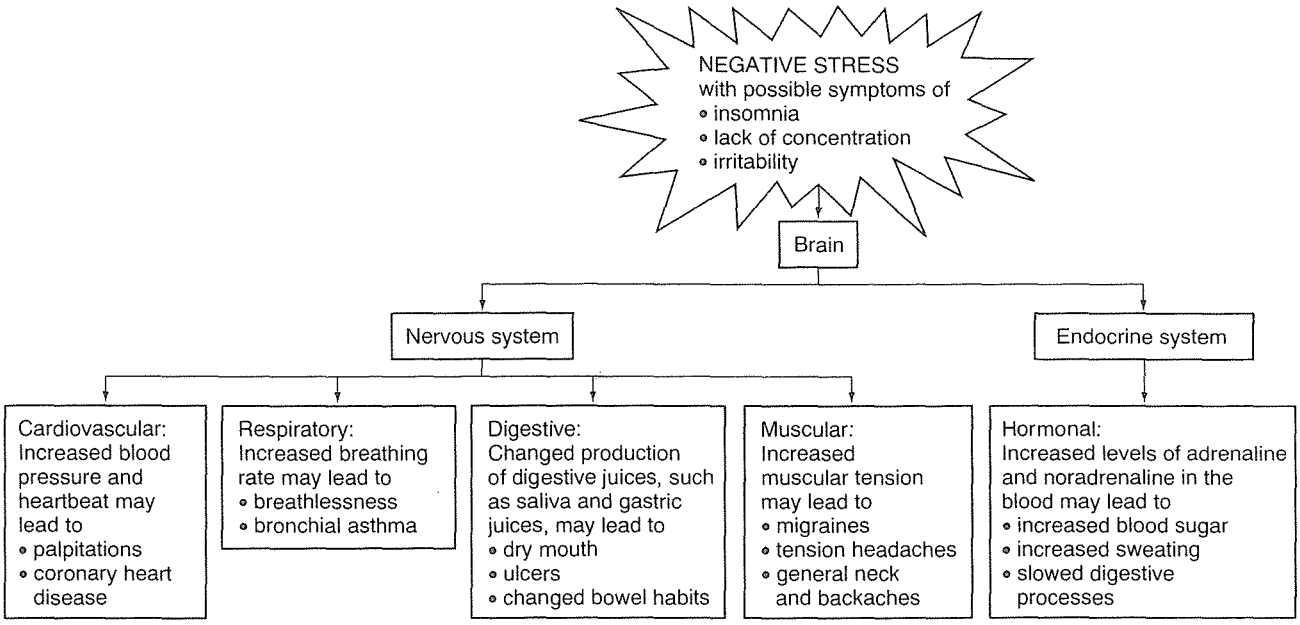


Stress—What do you know about it?

Part A: Stress

All people suffer from some stress reactions at one time or another. The body usually regains its balance quickly, and long term effects are not a problem. Positive stress gets you motivated to get things done. Negative stress occurs when you feel you cannot cope with a situation.

The diagram shows a simplified version of some of the effects of stress reactions on the human body.



Answer the following questions in your notebook.

1. Use the diagram to draw up a list of possible symptoms for a stressed person.
2. List at least four examples of stressful situations, including at least two positive and two negative situations.
3. Use biology textbooks to find out what noradrenaline is.
4. People often claim that cigarettes and alcohol relieve their stress. Comment on this claim, considering that cigarettes and alcohol may raise blood pressure for some people.
5. People who are stressed are often more accident-prone than the general population. What particular aspect of stress may cause this tendency?

Part B: What to do about stress

Before you can deal with stress, you need to know what your stressors (or things that cause you stress) are, and your response to these stressors.

If you feel stressed, three things to try immediately are:

- find somewhere quiet,
- control your breathing, and
- relax your muscles—face and shoulders are good places to start.

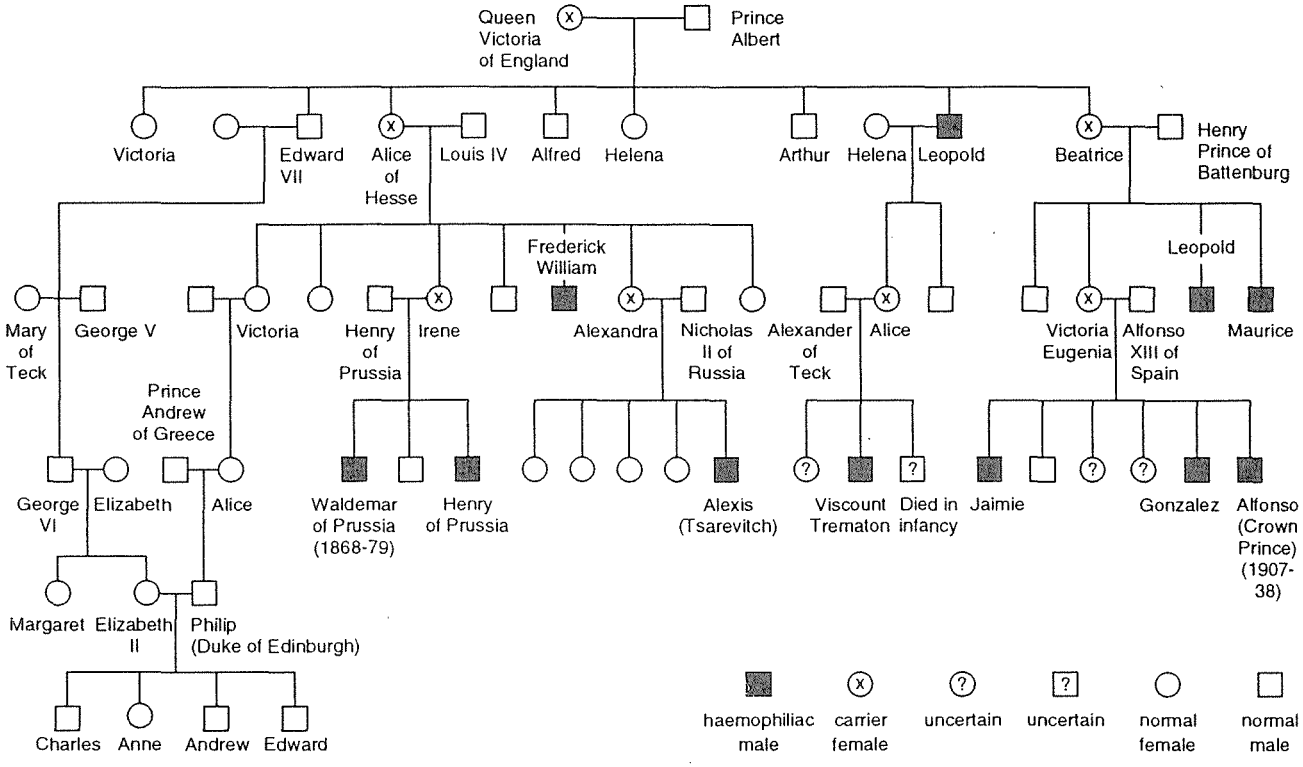
In the longer term, stress may be managed by using some of the following ideas: try talking it out, putting the problem on paper, shrugging it off, postponing it until you feel better, exploring other options, laughing it off, having positive thoughts, imagining the worst possible outcome and considering how likely that outcome really is, and goal-setting.

Since everyone is an individual, everyone will manage their stress differently. In some cases outside help from a counsellor may be useful.

6. Consider your own reactions. List at least two good and two bad stressors, and your responses to these stressors.

Haemophilia and the royal families of Europe

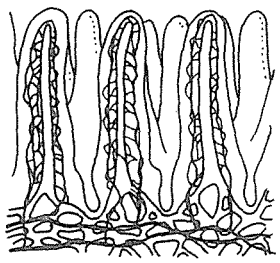
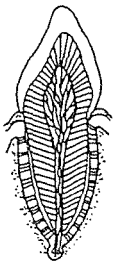
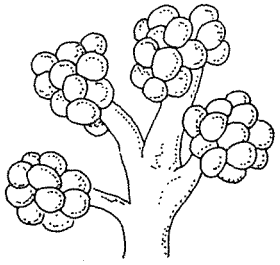
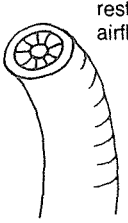
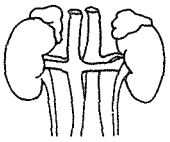
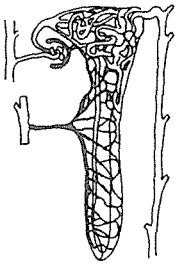
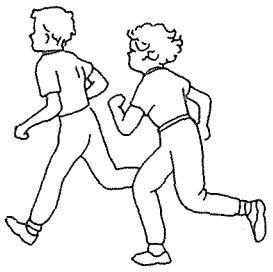
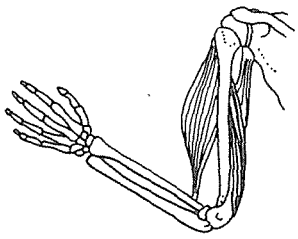
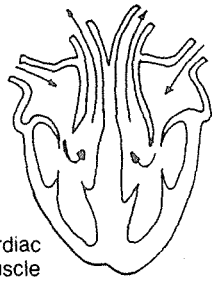
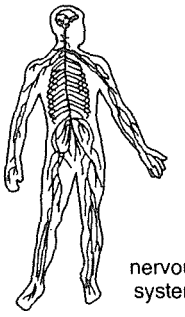
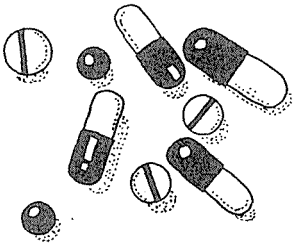
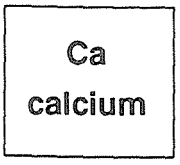
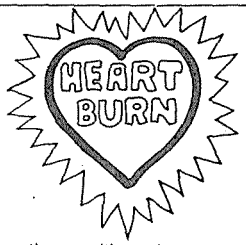
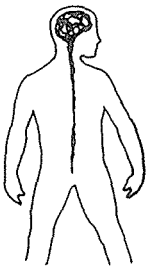
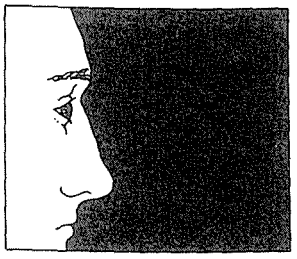
The pedigree of some European royal families, showing the inheritance of haemophilia, is given below.



Use the diagram to answer the questions.

1. Queen Victoria must have had the recessive gene and passed it on to her children. Name the affected children (include female carriers).
2. Use the pedigree to find out the names of:
   (a) the mothers who were carriers
   (b) the haemophiliac sufferers.
3. What percentage of:
   (a) females were carriers
   (b) males were haemophiliacs?
4. To which countries did the affected royal families belong?
5. Imagine that Mary of Teck had been a carrier for haemophilia. Discuss the possible consequences for the British royal family.
6. (a) Use the following information to draw up a pedigree for an imaginary family who suffers from a sex-linked genetic disorder. Remember to include all carriers in your pedigree.
   (i) Doug and Druscilla (a carrier) Cabbage have two children, David (a sufferer) and Daisy.
   (ii) David married Sandy and they have three children, Jane (a carrier), Edward and John.
   (iii) Daisy married Fernando and they have two children, Freddie (a sufferer) and Nicole.
   (b) What are the chances, if any, of:
   (i) Edward being a sufferer
   (ii) Nicole being a carrier?
   Explain your answers.
7. Throughout the world there are rules and laws forbidding marriage between close family members. Why do you think that these rules exist?

The body: Bingo cards

 villi	 canine (tooth)	 alveoli	bronchi have restricted airflow  asthma
 arteries	kidneys 	 nephron	 exercise
 muscles	 cardiac muscle	 nervous system	 hormone
21st pair  Down syndrome may occur	 drugs	 alcohol	 Calcium
 heartburn, although the heart is not involved	small valves  veins	spinal cord 	 night blindness

The body: Bingo clues

These help food digestion. *(villi)*	This part of the digestive system is a word that is also used to describe dogs in general. [*canine (tooth)*]	These structures are one cell thick, and oxygen dissolves in water and diffuses across them. *(alveoli)*	A breathing disorder that may be brought on by allergens that affect the bronchi. *(asthma)*
Parts of the circulatory system that have thick muscular walls. *(arteries)*	The organ that filters blood and removes liquid wastes. *(kidneys)*	Microscopic structures in the kidneys. *(nephron)*	This activity is needed to ensure that the heart and other body organs are kept in peak condition. *(exercise)*
Parts of the body that help the bones to move. *(muscles)*	Type of muscle found in the walls of the heart. *(cardiac)*	The system that controls muscular and skeletal movement. *(the nervous system)*	Insulin is one of these substances. *(a hormone)*
A disorder that often results because there are three chromosomes instead of two in the 21st pair. *(Down syndrome)*	Substances used to make the body feel better. *(drugs)*	One potentially dangerous and common, legal drug used by some people to help them to relax. *(alcohol)*	A deficiency of this substance may lead to rickets, soft teeth and bones. *(calcium)*
Excessive production of hydrochloric acid or overstretching of stomach due to over-eating or accumulation of gas. *(heartburn)*	These blood vessels have valves to ensure that blood may only pass in one direction. *(veins)*	Paralysis may occur if nerves in this area are damaged. *(the spinal cord)*	Lack of vitamin A may cause this disorder. *(night blindness)*

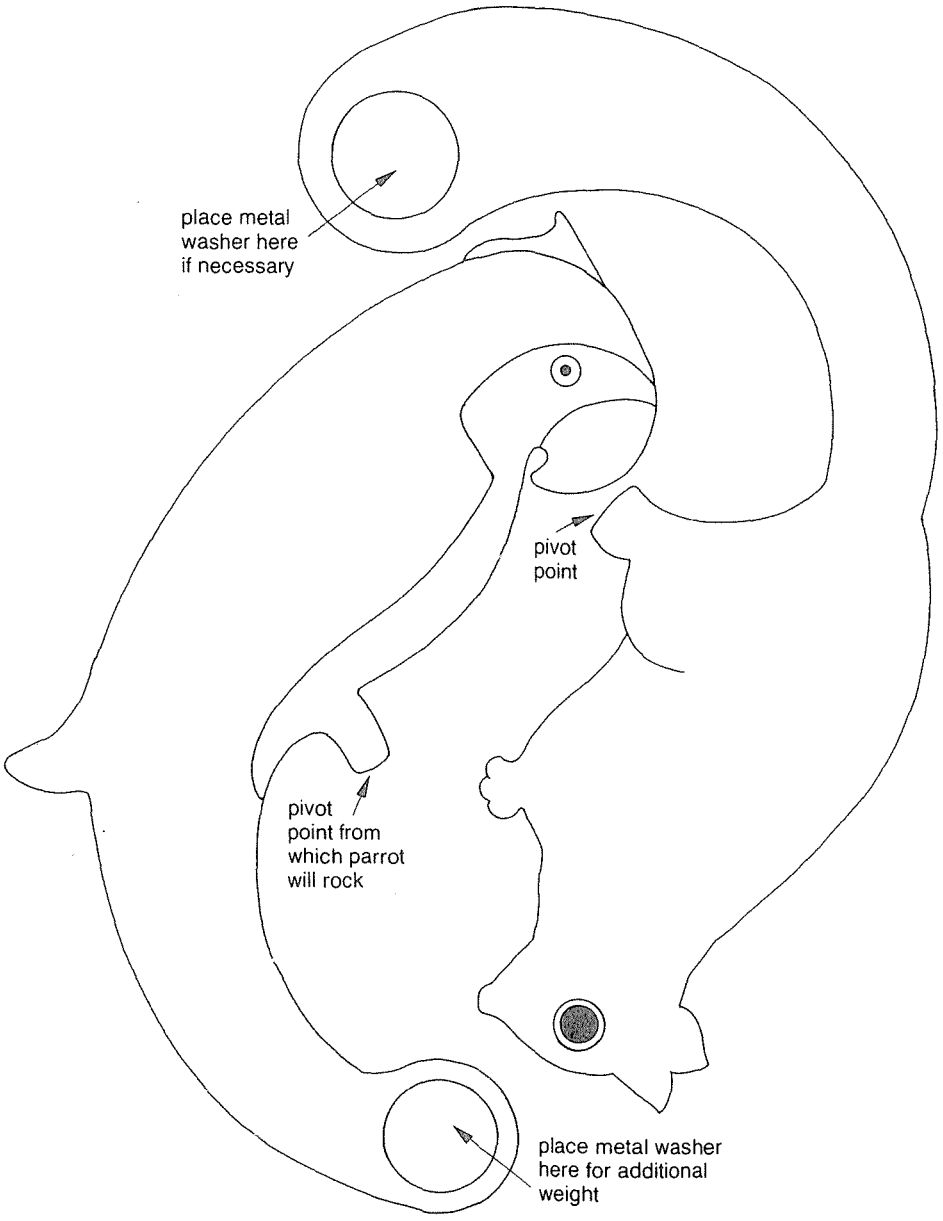
Answers are in brackets in italics. Do not read them out.

Balance toys

Two patterns for toys that use the idea of centre of mass are given on this page. Cut these shapes from thick cardboard or thin plywood. See if you can get the shape to balance by placing its pivot point near the edge of a table.

You might like to try these ideas too.

- Design your own balancing toy. You might like to try making different shapes, such as a pole vaulter.
- Design a 3-D toy that has a low centre of mass, so that it becomes a topple toy that cannot be knocked over.
- Balance two forks on a plastic cup, by pushing their prongs into a potato.



Note: Metal washers may need to be attached on the tails, as shown, to lower the centre of mass.

Activity 3.13: Inertia and cars

In this activity you will be investigating several types of collision, in which a moving vehicle, a toy car, collides with:

(a) a wall
(b) a stationary vehicle (i) from the rear
(ii) head-on
(c) another moving vehicle (i) from the rear
(ii) head-on

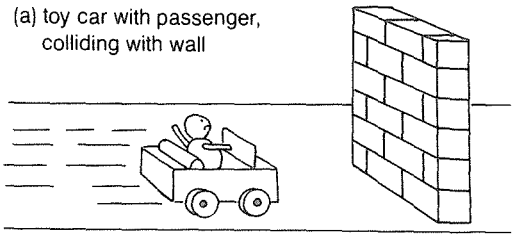
Observe the motion of the passenger in/on each vehicle closely during each collision.

What you need: # toy cars
small dolls/Plasticene and toothpicks to make dolls
books to provide walls and inclined planes

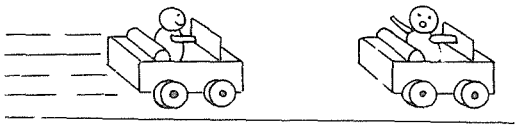
What you do: 1. Carry out the collisions shown in the diagrams.

2. Observe each collision, particularly at the instant of impact and when the vehicles come to rest. If a video camera is available, record the collision and play it back in slow motion, or frame by frame.

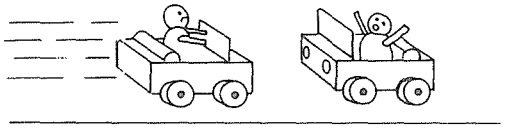
(a) toy car with passenger, colliding with wall



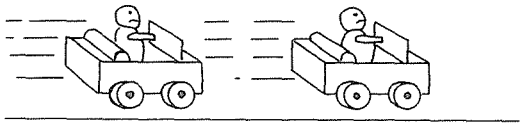
(b) (i) stationary vehicle being hit from the rear



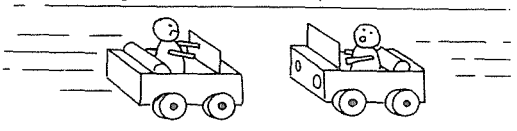
(ii) stationary vehicle being hit head-on



(c) (i) moving vehicles collide (travelling in the same direction)



(ii) moving vehicles collide (travelling towards each other)



Results
Record all your observations in a table.

Questions
1. Describe each of the collisions in terms of the inertia of the vehicle and passenger.
2. Why do you think that seat belts have been made compulsory in cars?
3. How would the seat belt affect a passenger during a collision?

Research
4. (a) Do you think that seat belts might cause injuries in certain circumstances?
(b) If injuries do occur, would these be greater with or without a seat belt?
5. Why do racing cars have different seat belts to family cars?
6. Air bags are now being used in some cars as a safety device. In what type of collision would an air bag be most effective? What type of movement/s do air bags stop? Do you think that air bags are a good idea? Explain your answer.

Motion equations

Complete the following table:

Equation in words	*Equation in symbols*	*Unit used for quantity on left-hand side (abbreviation)*
Newton's second law: force equals _____ times acceleration	$F = ma$	newton (___)
average _____ = total distance/total time	$v_{av.} = \frac{s}{t}$	metre per second (___)
acceleration equals change in _____ divided by time	$a = \frac{v - u}{t}$	_____ (ms^{-2})
_____ equals mass times velocity	$p =$ ___	kilogram metre per second (___)
_____ done	$W = Fs$	joule (___)
kinetic _____	$KE = \frac{1}{2}mv^2$	_____ (___)
_____ potential	$GPE = mgh$	_____ (___)
_____		(___)

Use information from your completed table to answer these questions in your notebook.

1. What force has been applied to a mass of 7 kg that is accelerating at 8 ms^{-2}?
2. How much work has been done when a force of 6 N has moved an object 6 m?
3. What gravitational potential energy does a 3 kg object have, when it is perched on the edge of a 60 m high cliff? (Take the acceleration due to gravity to be 10 ms^{-2}.)
4. What kinetic energy would a mass of 5 kg travelling at 24 ms^{-1} possess?
5. What momentum would a ball of mass 1.5 kg moving at 3 ms^{-1} have?
6. A car travelled 60 m in 15 s. What was the average velocity of the car?
7. A toy train was accelerating as it moved down the track. Its initial velocity was 0.5 ms^{-1}. After 10 s its velocity was 2.0 ms^{-1}. What was the toy train's acceleration?
8. How much kinetic energy would a 2000 kg truck have if it was moving at 6 ms^{-1}?
9. If an object had an average velocity of 10 ms^{-1}, and it had been moving for 14 s, how far would the object have travelled during that time?
10. The momentum of an object of mass 12 kg was measured as 156 $kgms^{-1}$. At what velocity was the object travelling when its momentum was measured?

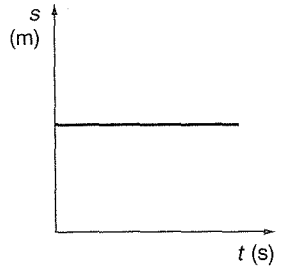
Motion graphs for easy reference

Remember only three things may be obtained from any graph!

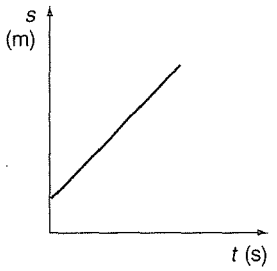
- values may be read straight from the graph;
- the gradient may be calculated using $\frac{\text{rise}}{\text{run}}$ or $\frac{y_2 - y_1}{x_2 - x_1}$;
- the area under the graph may be calculated.

Displacement-time (s–t) graphs

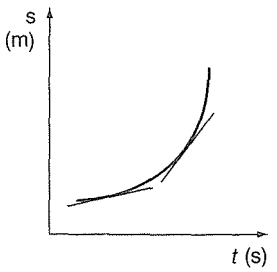
The velocity may be calculated by finding the slope or gradient of a displacement–time graph.



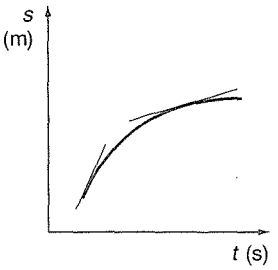
no motion
no velocity
no acceleration



constant velocity
no acceleration



gradient increasing
∴velocity increasing
acceleration

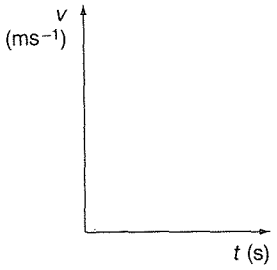


gradient decreasing
∴velocity decreasing
deceleration

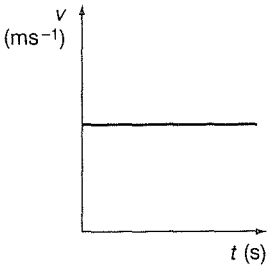
Velocity-time (v–t) graphs

The acceleration may be calculated by finding the slope or gradient of a velocity–time graph.

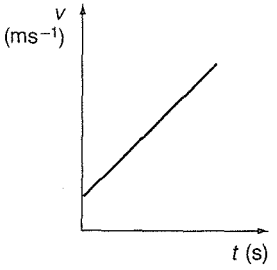
The displacement may be calculated by finding the area under the velocity–time graph.



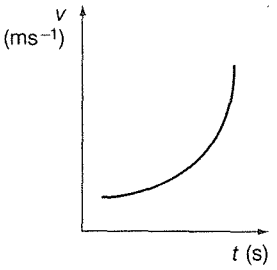
along t-axis
no motion
at rest



constant velocity
no acceleration
(no resultant force)



constant acceleration
(resultant force)



non-constant acceleration
(resultant force)

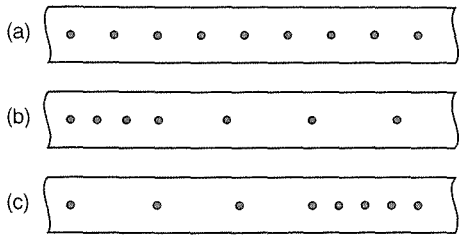
Use units to help you to remember.

- Gradient of an s–t graph $= \frac{s}{t} = \frac{\text{metre}}{\text{second}} = ms^{-1}$ = velocity
- Gradient of an v–t graph $= \frac{v}{t} = \frac{\text{metre/second}}{\text{second}} = ms^{-2}$ = acceleration
- Area under a v–t graph = $v \times t$ = (metre/second) × second = m = displacement

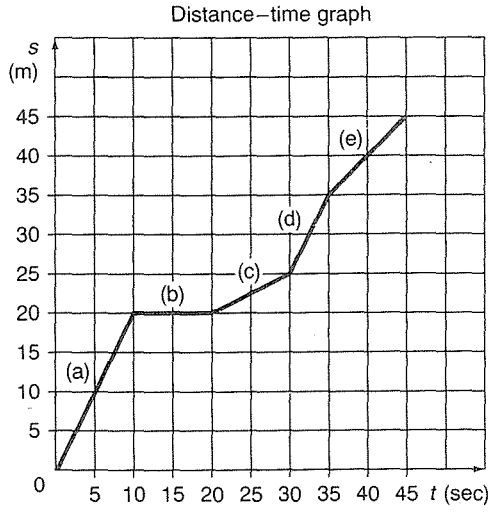
Measuring motion

Answer these questions in your notebook. You may need to use a calculator.

1. What are the units of distance, time, speed and acceleration?
2. What is the equation used to calculate:
   (a) average speed, in terms of distance and time?
   (b) acceleration, in terms of speed and time?
3. Calculate the average speed for:
   (a) a car that moves 500 m in 30 s
   (b) a jogger who runs 100 m in 50 s
4. A car starting from rest is travelling at 30 ms^{-1} after 90 s. Calculate the car's acceleration.
5. Describe the motion for each of the following ticker tapes.



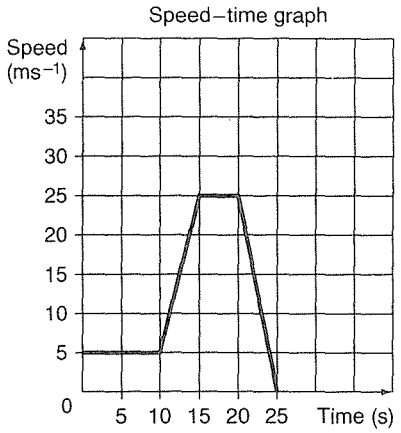
6. Work out the speed for each of the following straight line sections of the graph below:
   (a) 0–10 s
   (b) 10–20 s
   (c) 20–30 s
   (d) 30–35 s
   (e) 35–45 s



7. (a) Use graph or grid paper to plot the following information on a distance–time graph.

Time (s)	0	5	10	15	20	25	30	35
Distance (m)	0	5	15	25	35	35	40	45

   (b) During which time interval was the maximum speed reached?
   (c) What was the maximum speed?
   (d) During which time interval was the object at rest?
8. Describe the appearance of the distance–time graph for each of the following:
   (a) an accelerating object
   (b) an object moving at constant speed
   (c) a stationary object
9. Describe the appearance of the speed–time graph for (a), (b) and (c) in Question 6. (You may need to sketch the graph first.)
10. (a) Calculate the acceleration for each of the straight line sections of the following graph.
    (i) 0–10 s
    (ii) 10–15 s
    (iii) 15–20 s
    (iv) 20–25 s



   (b) Calculate the total distance travelled from time = 0 until time = 25 s.
   (c) Describe the motion represented by the graph.

Energy and falling

Using the information and sample calculations, answer the questions that follow.

Since the law of conservation of energy says that energy cannot be created or destroyed, sometimes the velocity of a falling object can be calculated from knowledge of its potential energy.

For example, to answer questions about the roller coaster, the following assumptions need to be made:

- at the top of the first hill, the roller coaster's energy is all gravitational potential (given by
  $$GPE = mgh$$
  where m is the mass in kilograms,
  g is the acceleration due to gravity, taken as 10 ms^{-2} for this exercise, and
  h is the height in metres)
- at the bottom of the first dip, the roller coaster's gravitational potential energy has all been converted to kinetic energy (given by
  $$KE = \tfrac{1}{2} mv^2$$
  where m is the mass in kilograms and
  v is the velocity in metres per second)

So
$$GPE_{top} = KE_{bottom}$$
or $$mgh = \tfrac{1}{2} mv^2$$
or $$gh = \tfrac{1}{2} v^2$$

Rearranging the equation:
$$v^2 = 2gh$$
so the maximum velocity at the bottom of the hill may be calculated.

Sample calculations

Example 1: The train on a large roller coaster falls 30 metres from the top of the first hill, to the bottom of the first dip. What is the maximum possible speed of the roller coaster at the bottom of the dip?

Using the equation that was just determined:
$$v^2 = 2gh$$
$$v^2 = 2 \times 10\ ms^{-2} \times 30\ m$$
$$= 600\ m^2s^{-2}$$
$$\text{so } v = 24.5\ ms^{-1}$$
The maximum possible speed at the bottom of the dip is 24.5 ms^{-1}.

Example 2: At the bottom of a hill the maximum velocity of a roller coaster was 20 ms^{-1}. What was the height from which it fell?

Using the equation:
$$v^2 = 2gh$$
then $$20\ ms^{-1} \times 20\ ms^{-1} = 2 \times 10\ ms^{-2} \times h$$
then $$h = \frac{20\ ms^{-1} \times 20\ ms^{-1}}{2 \times 10\ ms^{-2}}$$
so $$h = 20\ m$$

The height from which the roller coaster fell was 20 m.

Questions

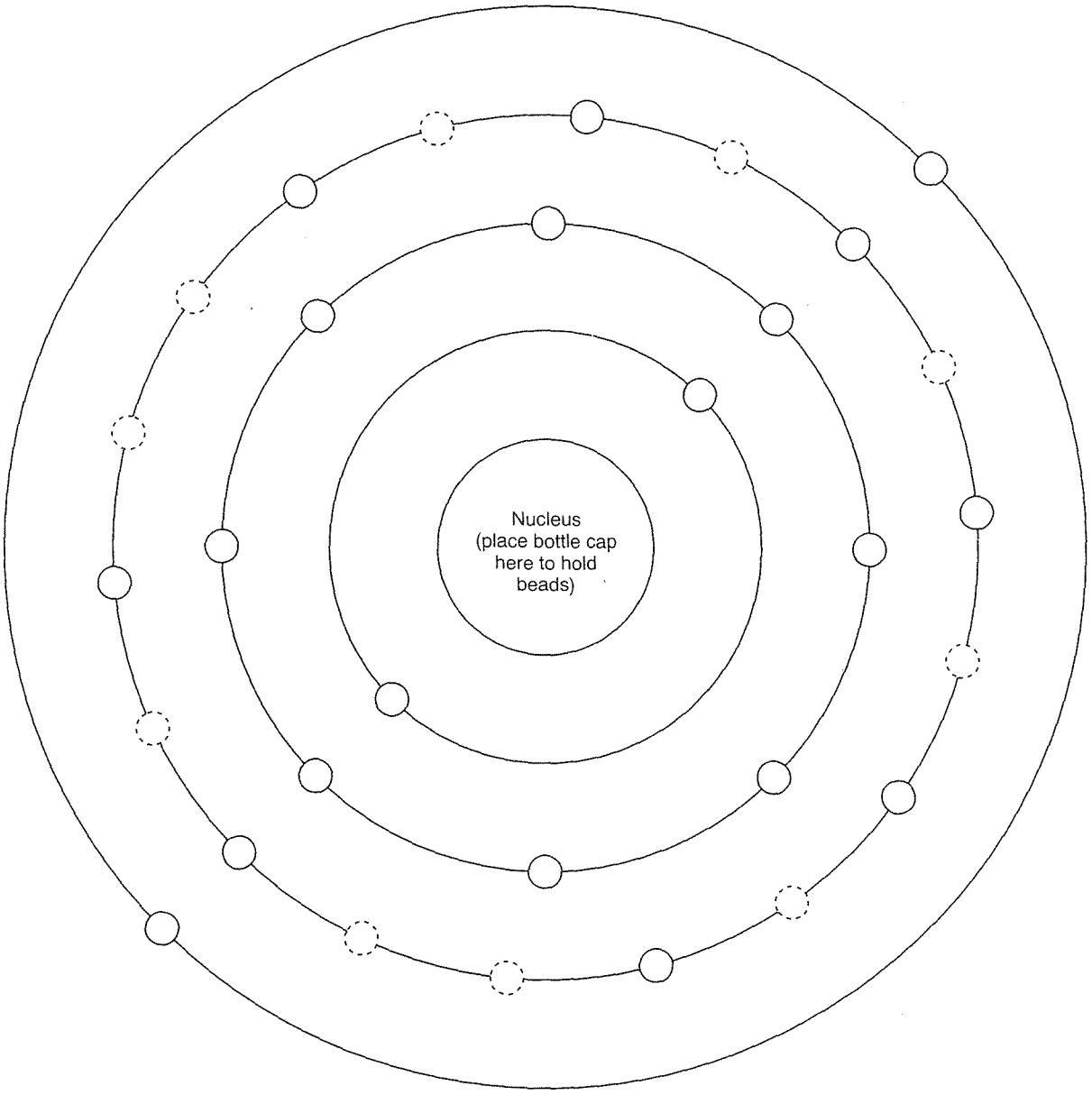
1. A smaller roller coaster falls 15 m from the top of the first hill to the bottom of the first dip. What is the maximum velocity of this roller coaster at the lowest part of the first dip?
2. On the next dip, the roller coaster drops only 5 m. What is the maximum velocity of this roller coaster at the lowest part of the second dip?
3. At the bottom of a hill, a roller coaster had a maximum velocity of 15 ms^{-1}. From what height had it dropped?
4. At the bottom of its flight, a compartment on a Ferris wheel was moving at 10 ms^{-1}. From what height had it dropped?
5. A rock fell from a cliff. It hit the water at a speed of 20 ms^{-1}. How high was the cliff from which it had fallen?

   Hint: You use exactly the same equations!
6. A drop of water fell 50 m over a waterfall. Assuming that its motion was not affected by anything other than gravity, at what speed did it rejoin the river at the end of its fall?

Something to think about

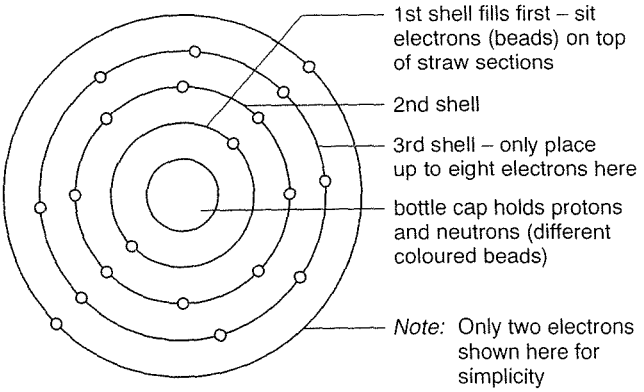
We have assumed that all the potential energy has been converted into kinetic energy. Is this a valid assumption? Explain your answer.

Model of an atom



Instructions

1. Paste the photocopied model onto thick cardboard.
2. Place a bottle cap 'nucleus' in the centre of the atomic model.
3. Stick pieces of straw onto the small solid circles only.
4. Build up atomic and ionic models, using various numbers of proton, neutron and electron 'beads'.



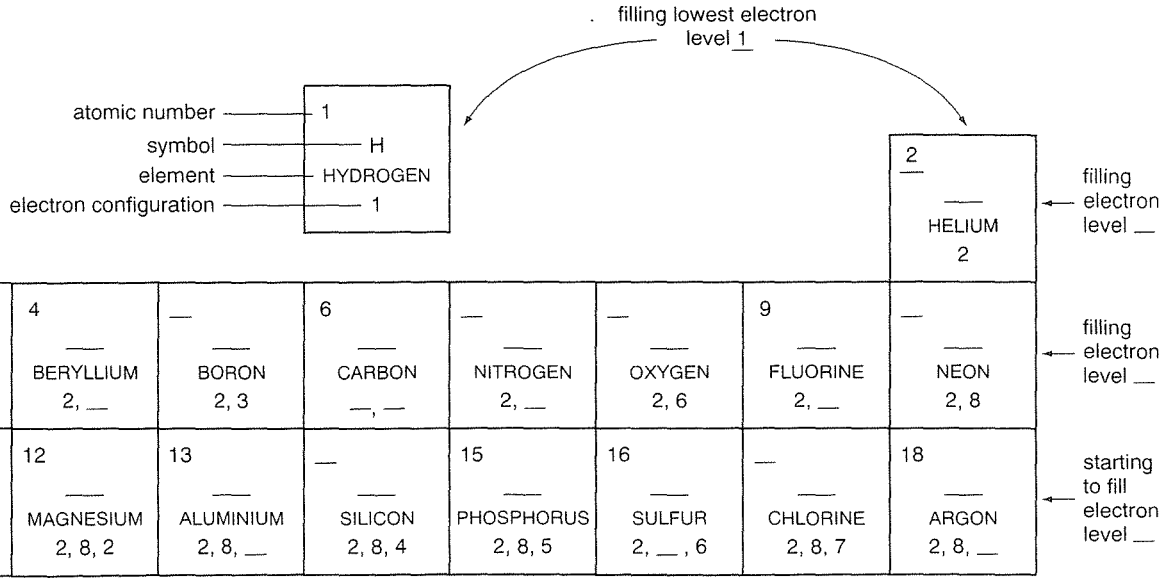
Another look at the first twenty elements

1. Complete the following table, as you work through Chapter 4, Holding matter together.

Atomic number	*Element*	*Symbol in equation*	*Number of protons*	*Electron arrangement*	*Mass number**	*Number of neutrons*
1	hydrogen	$H_{2(g)}$	1	1	1	0
2	helium	$He_{(g)}$	2	2	4	2
3	lithium	$Li_{(s)}$	3	2, 1	7	—
4	beryllium	$Be_{(s)}$	4	2, 2	9	5
5	boron	$B_{(s)}$	5	2, 3	11	—
6	carbon	$C_{(s)}$	—	2, 4	12	—
7	nitrogen	$N_{2(g)}$	7	2, —	14	—
8	oxygen	$O_{2(g)}$	—	—, 6	16	—
9	fluorine	$F_{2(g)}$	9	—, —	19	10
10	neon	$Ne_{(g)}$	10	2, 8	20	—
11	sodium	$Na_{(s)}$	11	2, 8, 1	23	—
12	magnesium	$Mg_{(s)}$	12	2, 8, 2	24	—
13	aluminium	$Al_{(s)}$	—	2, 8, —	27	14
14	silicon	$Si_{(s)}$	—	2, —, 4	28	—
15	phosphorus	$P_{(s)}$	15	—, 8, 5	31	—
16	sulfur	$S_{(s)}$	—	—, —, —	32	16
17	chlorine	$Cl_{2(g)}$	—	—, —, —	35	18
18	argon	$Ar_{(g)}$	18	2, —, 8	40	—
19	potassium	$K_{(s)}$	—	2, 8, 8, 1	39	20
20	calcium	$Ca_{(s)}$	—	2, 8, 8, 2	40	—

* Mass number of most common isotope

2. Complete the following simplified periodic table, including the symbol for each element and its electronic configuration.



Carbon compounds

Part A: Naming organic compounds

Remember that:

- the prefixes correspond to the following number of carbon atoms in the compound:
  meth- = 1 eth- = 2 prop- = 3 but- = 4 pent- = 5
  hex- = 6 hept- = 7 oct- = 8 non- = 9 dec- = 10
- the suffixes describe the compound:
  alkanes end in -ane
  alkenes end in -ene
  alkynes end in -yne

Complete the following table, that shows the systematic name and chemical formulas for the first ten alkanes, together with names and formulas for the first nine alkenes and alkynes.

Name of alkane	*Chemical formula* CnH_{2n+2}*	*Name of alkene*	*Chemical formula^ C_nH_{2n}*	*Name of alkyne*	*Chemical formula' C_nH_{2n-2}*
methane	CH_4	none	none	none	none
ethane	C_2H_6	___ ene	C_2H_4	eth ___	___
prop ___	C_3H_8	prop ___	___	___ yne	C_3H_4
butane	C_4H_{10}	___ ene	C_4H_8	butyne	C_4H_6
pent ___	C_5H_{12}	pentene	C_5H_{10}	___ yne	___
___ ane	C_6H_{14}	hexene	C_6H_{12}	hexyne	C_6H_{10}
heptane	___	hept ___	C_7H_{14}	___ yne	___
octane	C_8H_{18}	octene	C_8H_{16}	___ yne	C_8H_{14}
___ ane	___	nonene	C_9H_{18}	nonyne	C_9H_{16}
decane	$C_{10}H_{22}$	dec ___	$C_{10}H_{20}$	___ yne	___

* The general formula for an alkane is C_nH_{2n+2}
^ The general formula for an alkene is C_nH_{2n}
' The general formula for an alkyne is C_nH_{2n-2}

Part B: What is that compound?

1. Name the compound that has:
   (a) 5 carbon atoms and all single bonds
   (b) 9 carbon atoms and 1 double bond
   (c) 3 carbon atoms and 1 triple bond
   (d) 7 carbon atoms and 1 triple bond
   (e) 4 carbon atoms and 1 double bond.
2. Draw a possible structure for each of the following:
   (a) butane
   (b) ethene
   (c) propyne
   (d) methane
   (e) pentane

Research

Some carbon compounds, such as acetylene and acetic acid, are still commonly known by these non-systematic names. See how many other 'old' names you can find. Find out their corresponding systematic names too.

Bonding Earth-style

New extraterrestrials (the ET2s) from the fifth dimension landed on the Earth, ready to investigate how matter held together. The ET2s had the following table that had been translated into their coded language. Now all they had to do was to identify the types of bonding in the materials that they found around their flying saucer.

Type of bond	*Description*	*Characteristics of substances with this type of bonding*
metallic e.g. copper	cations in a sea of electrons	• high electrical conductivity • high melting point and boiling point (usually)
ionic e.g. sodium chloride	cations and anions held in a rigid framework	• no conductivity in solid state • conductivity when molten or dissolved, so ions are free to carry current • usually crystalline solids • high melting point and boiling point (usually)
covalent e.g. carbon dioxide	atoms share electrons	• no conductivity at all • often gases or low melting point liquids

The ET2s found five different samples: U, V, W, X and Y. Information about their samples is provided. It is your task to help the ET2s to identify the bonding in each of the samples. You must give reasons for your choice. (Use the table and your general knowledge.)

Sample	*Results of ET2s investigations*
U	• shiny, malleable, ductile, conducted electricity
V	• pure white crystals with a high melting point, conducted electricity when dissolved in water
W	• shiny liquid that conducted electricity
X	• gas having no conductivity
Y	• yellow powder that did not conduct electricity

1. List the bonding type for each sample, together with the reason/s for your choice.

   After the ET2s left Earth, the following substances were found at their landing site: sulfur, mercury, salt, copper and a gas jar containing sulfur dioxide gas.

2. Which substance corresponds to which letter?

3. The ET2s had been given instructions to find two substances, a reactive metal and an acid, and react them together. Explain what results the ET2s might expect. (Write an equation first, and then decide what type of bonding may be expected in the products.)

Research

Some of the hardest substances known have covalent bonds holding their atoms together. Use library books to find out the names of at least two of these substances, and why they are so hard.

Chemical formulas and equations

Part A: Chemical formulas

Write down the formula including the state (solid, liquid, gas or aqueous) for each of the following substances in the space provided. You may have to use a senior chemistry text to help with some of them. Number 1. is done for you.

Substance	*Formula*	*Substance*	*Formula*
1. hydrogen gas	$H_{2(g)}$	21. iron metal	_____
2. oxygen gas	_____	22. aqueous iron(II) chloride	_____
3. liquid water	_____	23. aqueous potassium hydroxide	_____
4. zinc metal	_____	24. aqueous potassium sulfate	_____
5. aqueous zinc chloride	_____	25. solid lead(II) sulfate	_____
6. magnesium metal	_____	26. liquid mercury	_____
7. aqueous magnesium chloride	_____	27. solid mercury(II) oxide	_____
8. solid calcium carbonate	_____	28. hydrogen chloride gas	_____
9. solid calcium oxide	_____	29. hydrochloric acid	_____
10. carbon dioxide gas	_____	30. solid copper sulfate	_____
11. carbon monoxide gas	_____	31. solid barium chloride	_____
12. ammonia gas	_____	32. nitrogen gas	_____
13. solid ammonium chloride	_____	33. liquid bromine	_____
14. aqueous sulfuric acid	_____	34. solid iodine	_____
15. solid ammonium sulfate	_____	35. argon gas	_____
16. copper metal	_____	36. ozone gas	_____
17. solid copper(II) oxide	_____	37. aluminium metal	_____
18. aqueous nitric acid	_____	38. solid aluminium oxide	_____
19. aqueous copper nitrate	_____	39. solid aluminium sulfate	_____
20. aqueous sodium chloride	_____	40. sulfur dioxide gas	_____

Part B: Equations

Use the formulas from Part A, together with a periodic table of elements, to help you change the following word equations into balanced formula equations.

You may either write these equations on the back of this sheet or in your notebook.

(a) magnesium metal + oxygen gas ⟶ solid magnesium oxide

(b) zinc metal + hydrochloric acid ⟶ aqueous zinc chloride + hydrogen gas

(c) magnesium metal + hydrochloric acid ⟶ aqueous magnesium chloride + hydrogen gas

(d) solid calcium carbonate ⟶ solid calcium oxide + carbon dioxide gas

(e) solid mercury(II) oxide ⟶ liquid mercury + oxygen gas

(f) ammonia gas + hydrogen chloride gas ⟶ solid ammonium chloride

(g) aluminium metal + oxygen gas ⟶ solid aluminium oxide

(h) solid sulfur + oxygen gas ⟶ sulfur dioxide gas

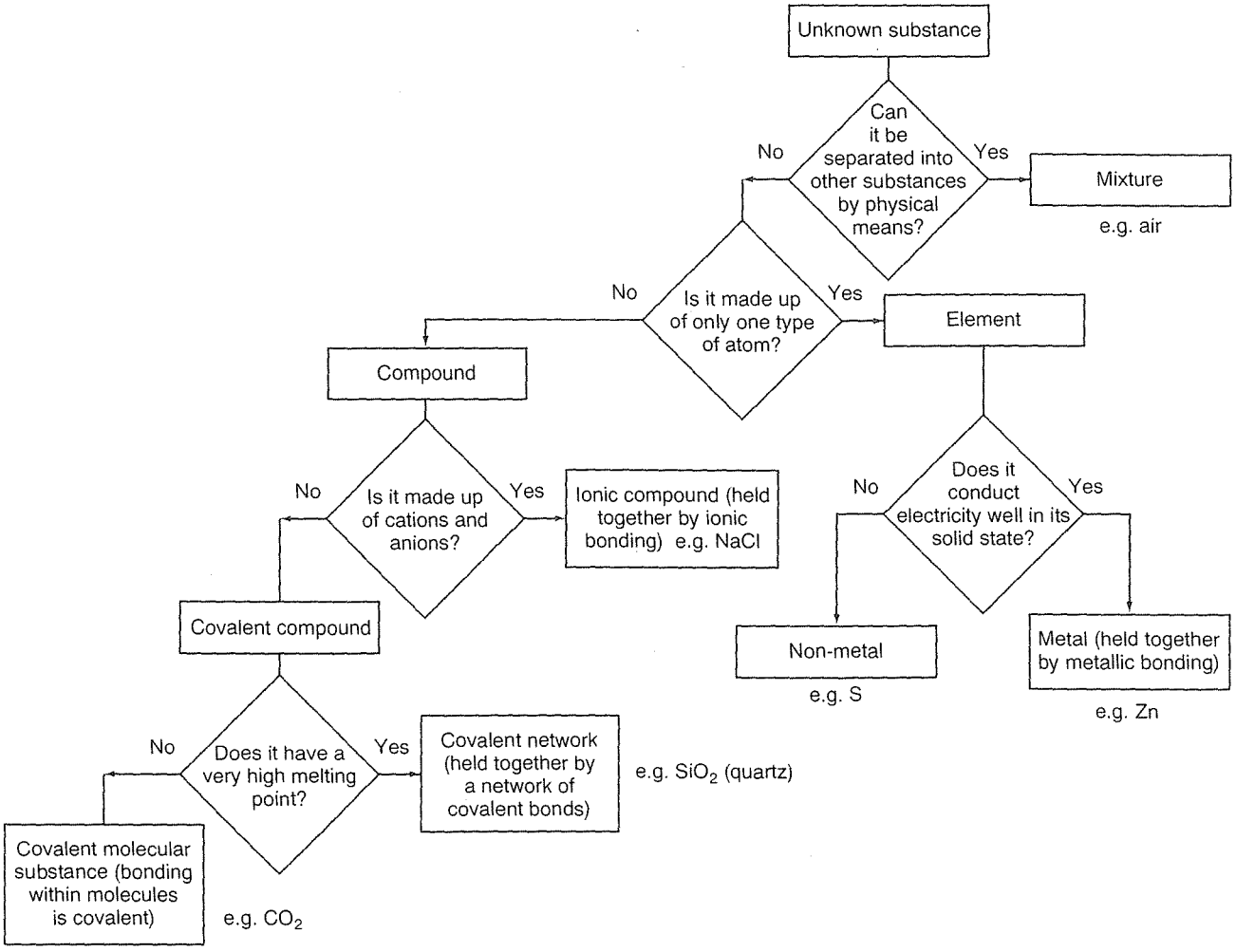
(i) nitrogen gas + hydrogen gas ⟶ ammonia gas

(j) aqueous potassium hydroxide + sulfuric acid ⟶ aqueous potassium sulfate + water

Research

Use library books to find out about ozone (O_3) and its importance.

Types of substances



Use the flow chart to answer the following questions.

1. What am I? For each of the following descriptions, you must decide whether I am a mixture, an element (metal or non-metal) or a compound (ionic or covalent).
   (a) I am a substance made up of only one type of atom and I do not conduct electricity at all.
   (b) I am a substance that has a very high melting point and I am made up of two types of atom.
   (c) I am made up of a cation and an anion.
   (d) I am shiny, solid, made up of one type of atom and I conduct electricity well.
   (e) My parts may be separated by physical means.
2. Construct a table of types of substances, together with at least one property and one example of each type of substance. Try to use examples other than those given in the flow chart.
3. Classify each of the following substances:
   (a) Diamond is a substance made up of one type of atom—carbon.
   (b) Napthalene is used in cupboards to kill moths. It is made up of more than one type of atom, and there are no ions present. It has a low melting point.
   (c) Soil varies from place to place, and many components may be separated from it by sieving, dissolution, evaporation and so on.
   (d) Sodium chloride is made up of sodium ions and chloride ions. It has a high melting point.
4. Using your chemical knowledge and Question 3(c) as a hint, describe the meaning of *physical means*.

Valency tables and jigsaw pieces

The valency tables are provided for your reference.

Valency of some common metals		
1+	2+	3+
Li^+ lithium	Mg^{2+} magnesium	Al^{3+} aluminium
Na^+ sodium	Ca^{2+} calcium	Fe^{3+} iron(III)
K^+ potassium	Fe^{2+} iron(II)	
Ag^+ silver	Cu^{2+} copper(II)	
Cu^+ copper(I)	Zn^{2+} zinc	
	Pb^{2+} lead(II)	

Note: The valency of the non-metal hydrogen (H) is also 1+. The valency of carbon may be 4+ or 4–.

Valency of some common non-metals		
1–	2–	3–
F^- fluoride (from fluorine)	O^{2-} oxide (from oxygen)	N^{3-} nitride (from nitrogen)
Cl^- chloride (from chlorine)	S^{2-} sulfide (from sulfur)	
Br^- bromide (from bromine)		
I^- iodide (from iodine)		

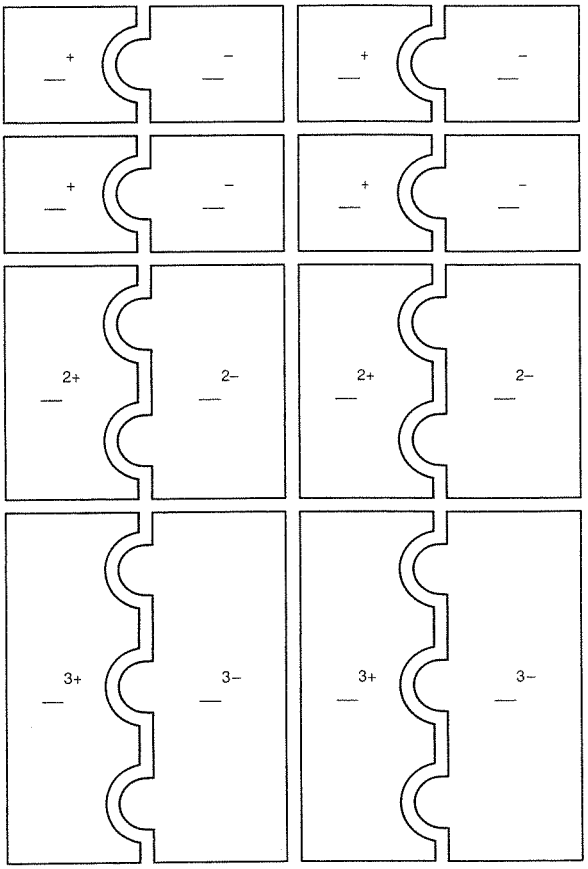
Valency of some common radicals		
1–	2–	3–
$(NO_3)^-$ nitrate	$(SO_4)^{2-}$ sulfate	$(PO_4)^{3-}$ phosphate
$(OH)^-$ hydroxide	$(CO_3)^{2-}$ carbonate	
$(HCO_3)^-$ hydrogen carbonate		
$(MnO_4)^-$ permanganate		

Note: The valency of the radical ammonium (NH_4) is 1+.

Jigsaw pieces

Finding the chemical formula for a substance using the 'valency crossing method' may be difficult for you. These jigsaw pieces are provided as an alternative. They may be:

- traced onto cardboard
- covered with adhesive paper (to make them more durable)
- cut out
- have chemical symbols or formulas written on them, using water-based pens
- cleaned and reused



Polywunder

Read the following article about a hypothetical polymer used to make disposable food containers, such as cups and plates. Use the article and your own general knowledge to carry out the activities and answer the questions.

Polywunder—the new wonder polymer material

Polywunder is a new and excitingly different material that is safe and convenient. Products made from this magnificent material have little impact on the environment, and they promise better hygiene in the food industry.

How often have you been in a restaurant and looked down at your plate and seen streaks of detergent across it? Detergents and valuable water have been used to clean the plate. These detergents are harmful to both you and the environment, and water wastage is a major concern.

Hygienic *Polywunder* cups and plates are now available. They provide the clean alternative for food outlets. These products are used once and then may be recycled or thrown away. Businesses can save time and money, because fewer staff are needed.

Environmental considerations are important too. No CFCs have been used in the manufacture of this polymer. The waste produced by the plates and cups is minimal, because the product may be recycled. If *Polywunder* should end up as landfill, it takes up little space because it crushes easily, and it does not biodegrade, so no harmful greenhouse gases are produced.

Questions

1. Discuss
   (a) the article and its accuracy,
   (b) how and whether the case for using *Polywunder* products could be improved.
2. Are any emotive arguments used in the article? If so, list it/them.
3. Why are CFCs mentioned? What problems do these gases cause?

Activities

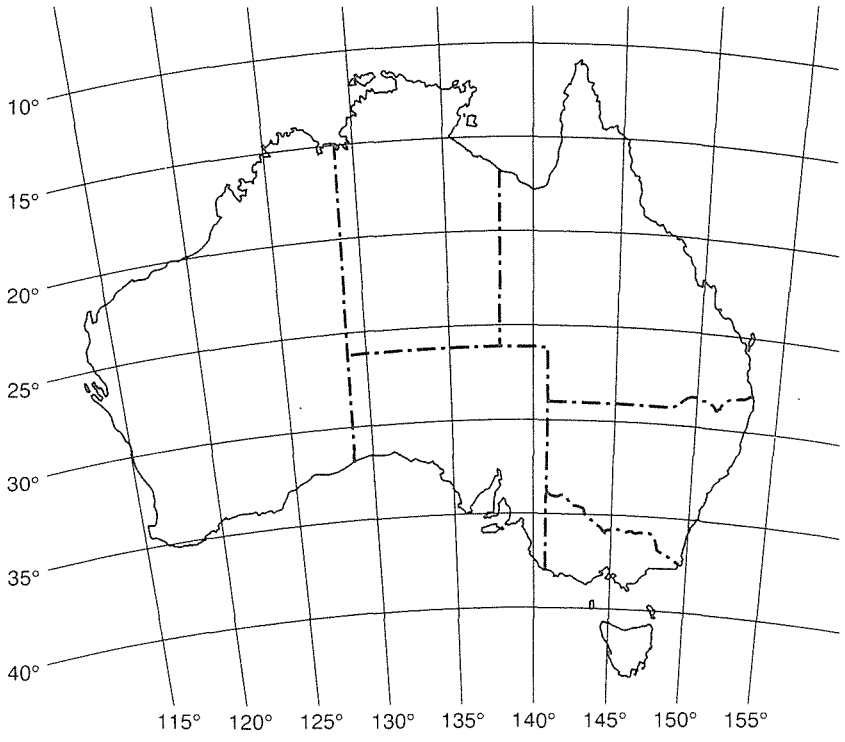
1. Design and produce advertising materials for *Polywunder*. You may include a poster, a pamphlet, an audio tape, a video tape or a jingle.
   (Remember to work out your marketing strategy first, by finding out who your target market is, working out pricing and so on.)
2. (a) Visit a supermarket and investigate the alternative products to *Polywunder*.
   (b) Compare one of these alternatives to *Polywunder* products. Prepare a brief report on your findings.
3. Contact manufacturers of different materials used in the packaging and/or the food and drink industry. Investigate which material/s are better/best.

Where in Australia?

1. Devise a key for each of the following substances: aluminium, iron, black coal, magnesite, uranium and zinc.
2. Use your key to plot the following places on the map. Their approximate positions are given in degrees.

Metal	*Place where ore is found*	*Latitude (approx.)*	*Longitude (approx.)*
aluminium	Gove (N.T.)	12.3S	136.8E
	Weipa (Qld)	12.7S	142.1E
black coal	Blackwater (Qld)	23.6S	148.9E
	Lithgow (N.S.W.)	33.5S	150.2E
	Ipswich (Qld)	27.4S	152.5E
brown coal	Yallourn (Vic.)	38.2S	146.4E
iron	Mt Newman (W.A.)	23.4S	119.8E
	Mt Tom Price (W.A.)	22.7S	117.9E
uranium	Mary Kathleen (Qld)	20.7S	139.9E
	Yeelirrie (W.A.)	27.3S	120.1E
zinc	Beltana (S.A.)	30.8S	138.4E
	Broken Hill (N.S.W.)	31.9S	141.5E
	Mt Isa (Qld)	20.7S	139.5E
	Rosebery (Tas.)	33.9S	151.2E

3. Use your text book, together with geology books, to find and plot at least five other places where these or other important ores are mined. Remember to include the magnesite deposit at Kunwarara (Qld) on your map.



Activities 5.1 and 5.2

Activity 5.1: Reactivity of metals

In this activity, you will be checking the reactivity of metals. If a metal reacts with cold water, do not react it with anything else.

What you need:

a variety of metals including calcium, magnesium, zinc, iron, lead and copper
tweezers for handling the metals
large beaker containing warm water
dilute acid solution
test-tube rack and test tubes
a taper and matches
steel wool or emery paper, to clean metallic surfaces to ensure that there are no oxide layers present

What you do:

1. Place about 2 cm height of water in each test tube in the rack.
2. To each test tube add a small piece of metal, and observe closely for a minute or so.

Do NOT react warm water with any metal that showed a reaction with cold water.

3. Decant the water, and place metal scraps in a container, that you will hand to your teacher at the end of the activity.
4. Repeat steps 1–3 using warm water.
5. Repeat steps 1–3 using dilute acid.

Take care with dilute acids! Wear goggles! Do not point the test tube towards anyone.

Results

Construct a table to record observations of the reaction of the metals with cold and warm water, and with dilute acid.

Questions

1. What metal/s appear/s to be:
   (a) most reactive? (b) least reactive?
2. Why were the matches and taper provided?
3. Using information learnt in *Dynamic Science Book 3* together with work from Chapter 4, write:
   (a) a word equation and
   (b) a balanced chemical equation,
   if a reaction occurs.

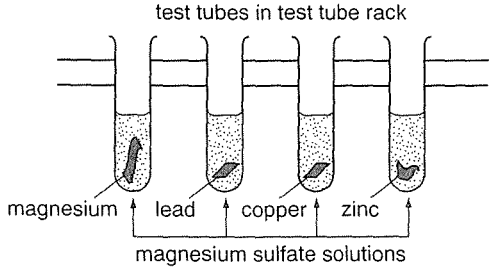
Activity 5.2: Metal-metal displacements

What you need:

solutions of magnesium sulfate, lead nitrate, copper sulfate and zinc nitrate (all approximately 0.25 mole/litre)
strips of magnesium, lead, copper and zinc
steel wool or emery paper
test-tube rack with test tubes

What you do:

1. Use one solution at a time to test each metal. Place a sample of each metal into a separate test tube, as shown in the diagram.



2. Add about 2 cm height of magnesium sulfate solution to each of the metals, and observe closely, for about 5 min.
3. Place used metal samples in the container provided.
4. Repeat steps 1–3 using the different solutions.

Results

Construct a table to record your observations of the metals with the metal salts.

Questions

1. What happens if a more reactive metal is placed into a solution containing the salt of a less reactive metal?
2. In what order of reactivity (from most reactive to least reactive) would you place magnesium, lead, copper and zinc?
3. Write: (a) a word equation and
   (b) a balanced chemical equation,
   if a reaction occurs.

Activity: Electrolysis: Nickel plating

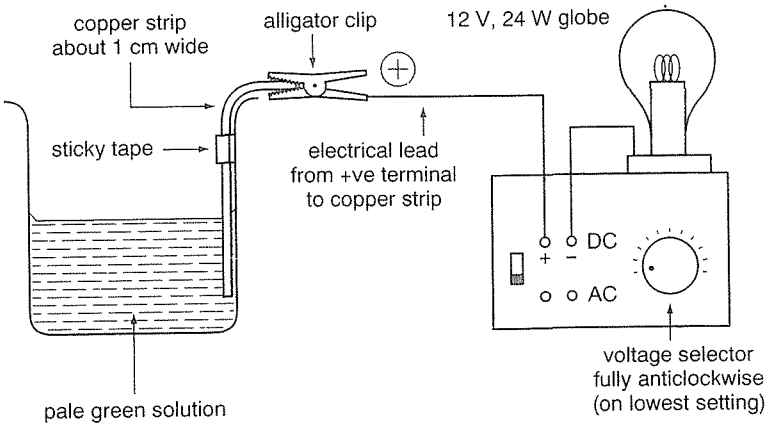
A patient chemistry student could use this method to plate a brass object, such as a key, with a hard, shiny layer of nickel. You may like to take before and after photographs of your object.

What you need:

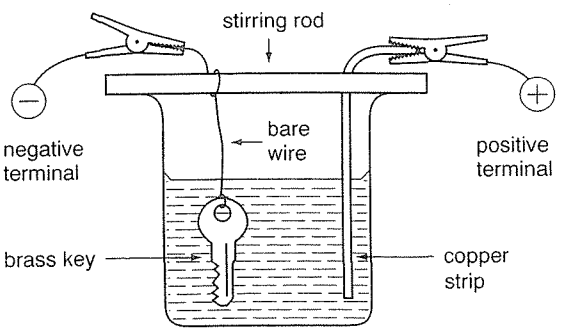
- # 20 mL of 0.5 M sulfuric acid
- # goggles (for use when heating acid)
- # 2 × 250 mL beakers
- # heating equipment (Bunsen burner, tripod, gauze mat and heat mat)
- # nickel carbonate (approximately one teaspoonful)
- # boric acid (approximately half a teaspoonful)
- # power pack
- # 3 electrical leads
- # light bulb
- # copper electrode (or strip of copper approximately 1 cm wide)
- # stirring rod
- # steel wool (plain with no soap impregnated in it)
- # bare piece of copper wire (approximately 10 cm long)

What you do:

1. Put on your goggles.
2. Carefully warm the sulfuric acid, adding small amounts of nickel carbonate to it until the fizzing stops and no more nickel carbonate will dissolve.
3. Allow the hot solution to settle.
4. Carefully decant the solution into another beaker.
5. Add about ½ teaspoonful of boric acid to the clear green solution and stir until it has dissolved.
6. Dilute the solution to 200 mL with water, and place to one side while the brass object (such as an old key) is cleaned.
7. Scrub the key thoroughly.
8. Set up the copper strip so that it is hard up against the glass on the side of the beaker.
9. Set up the equipment as shown in the diagram ensuring that the knob on the power pack is on the LOWEST setting. (The plating will be black rather than silver-coloured if the voltage is greater than 2 volts.)



10. WITHOUT PLACING THE KEY IN THE BEAKER YET, suspend it from the bare wire. Attach the wire to the negative terminal of the power pack.
11. Turn the power on. WITH THE POWER ON, place the key into the beaker taking care that:
    - the copper and the key do NOT touch each other, and that
    - the key does NOT touch the side of the beaker.
12. Allow the power to stay on for approximately 20 min. Remove the key and wash under running water. Observe the key closely.



Results

You may like to take photographs showing your object before and after coating. You could then display these together with the coated object.

Geological maps

Geological maps are effectively views of the rocks just beneath the Earth's surface. There are three main steps in the production of a geological map.

A. Locate outcrops of rocks in the field, and record observations and measurements related to these rocks.

B. Produce a base map to show the field details.

C. Construct a map to show the rock types at or beneath the Earth's surface in that particular area. This information may then be used to work out the geological history of the area.

Let us now consider each of the steps more closely. In step A, it is useful to work out:

(a) rock types present, and

(b) the dip and strike of sedimentary rock layers.

- The **strike** is the horizontal direction of the rock layers measured with a compass. (This angle will be between 0 and 360° because it is a compass bearing.)
- The **dip** is the angle at which the layer meets the horizontal. (This angle will be between 0 and 90°. Why?)

Note: Dip and strike are usually only used for sedimentary rocks.

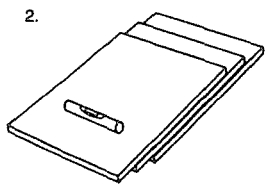
Activity: Practising working out strike and dip

What you need:

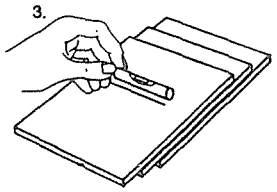
small spirit level
straight-sided compass
3 large heat-proof mats, old desk tops or hardcover books
wooden block or other textbooks to support the mats
protractor, ruler, pencil

What you do:

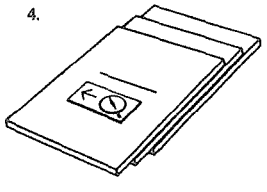
1. Set the heat mats at a stable angle using the wooden block or textbooks.
2. Lay the small spirit level across the sloping mats. Adjust the level until you have found the horizontal direction.
3. Rule a line in this direction.
4. Lay the straight-sided compass along the line, and read off the compass bearing. This is the strike.
5. Use a protractor and a ruler to mark in the perpendicular.
6. Use a protractor to measure the angle between the horizontal and the sloping mats. This is the dip.



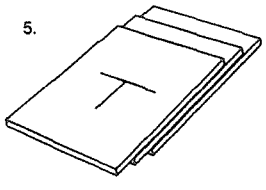
Find the horizontal direction on the mats



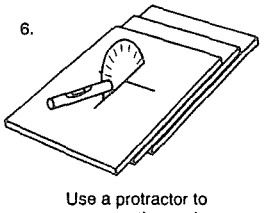
Rule a line in this horizontal direction



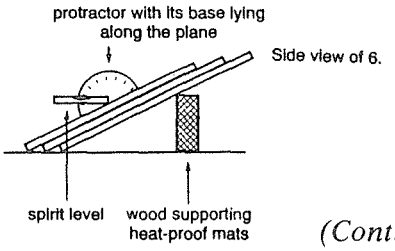
Read the strike from the compass



Mark a perpendicular line



Use a protractor to measure the angle



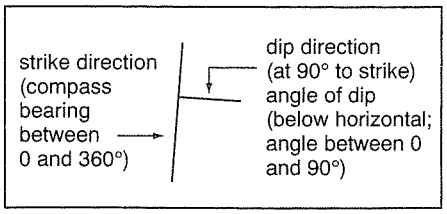
(Continued)

7. Twist the mats, so that both their slope and direction are changed.
8. Take dip and strike measurements.
9. Repeat steps 7 and 8.

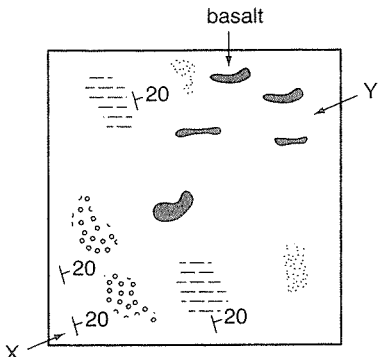
Results
Record the dip and strike of the mats, for the mats in at least three different positions.

Question
What did you notice about the position of the mats, when:
(a) the dip was the greatest?
(b) the dip was the smallest?

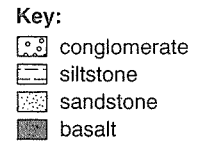
Steps B and C: Looking at results
Using knowledge of rock type, strike and dip, the following pictures of an area may be built up. Initially there is simply a map showing the rock types together with their strike and dip. From this map, major features may then be inferred. This second geological map is usually drawn in colour.

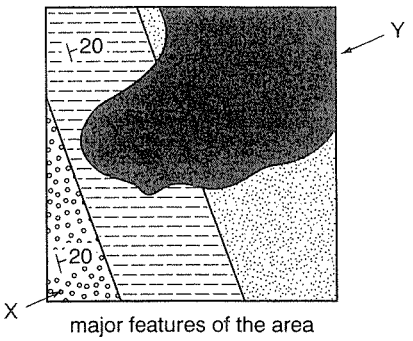


NOTE: This T-shape is used on geological maps to show the dip and strike directions



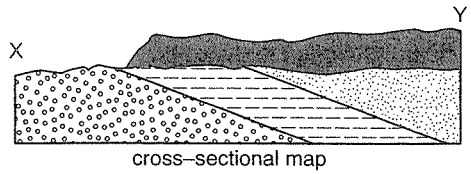
rock types with dip and strike





major features of the area

A cross-sectional map may then be inferred from the previous two diagrams.



cross–sectional map

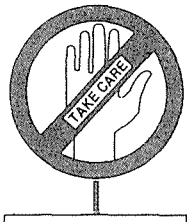
Question
What could you say about the geological history of the area shown in the diagrams?

Extra activity: Field trip

If there is an easily accessible local area, investigate rock types, dip and strike for that area. Try to draw up a geological map for the area.

Making a crystal set

Did you know that you can tune in to your favourite AM radio station with a simple device that you can build for yourself? It needs no batteries because the energy is provided by the AM radio transmitter.



Do NOT use gas pipes or electrical wires as attachments for your earth!

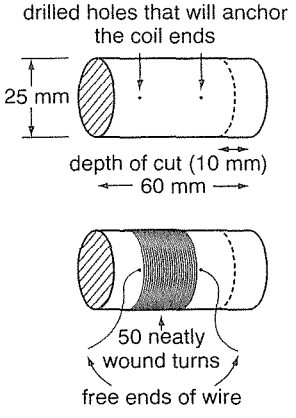
Do NOT use your completed crystal set or stand near its antenna during a thunderstorm.

What you need:

- # one piece of timber dowel approx. 25 mm diameter and 60 mm long, with a narrow saw-cut (about 10 mm deep) across one end to hold the circuit board
- # one piece of rigid plastic pipe with an inner diameter of approx. 28 mm and approx. 55 mm long
- # a drill with 1 mm, 4 mm and 6 mm bits
- # enamelled copper wire for the coils (30BS approx. 0.28 mm diameter)
- # a long piece of wire to attach to a high point, such as a tree
- # a signal diode (OA50, OA60, OA90 or OA91)
- # a capacitor (390 pF ceramic capacitor)
- # an earphone jack
- # a high impedance crystal earphone (a transistor earphone usually will NOT work)
- # a small piece of rigid plastic sheet (25 mm × 50 mm)
- # three small bolts with nuts and washers
- # sandpaper for removing enamelling from copper contacts

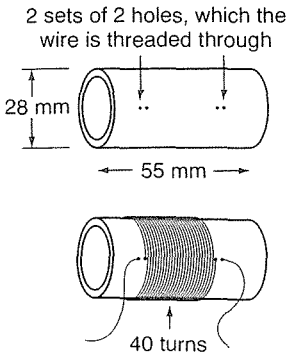
What you do: **To make the wooden-based coil**

1. Drill 2 holes through the wood approx. 22 mm apart, as shown in the diagram, away from the saw-cut, to hold the ends of the wire coil.
2. Leave about 220 mm of copper wire free, and anchor this wire by threading it through the drilled hole further away from the saw-cut.
3. Carefully wind approx. 50 turns of wire around the wood, keeping the other end of the wire free.
4. Cut the wire and thread the loose end of the wire through the hole nearer the saw-cut, leaving approx. 200 mm free.



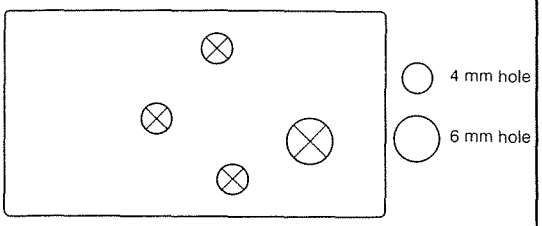
To make the plastic-based coil (that must fit around the outside of the wooden coil)

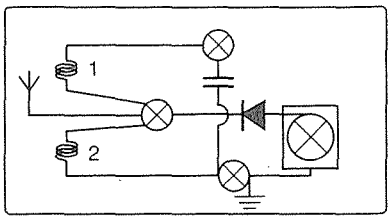
1. Drill 2 holes (approx. 1 mm diameter) close together approx. 20 mm from the ends (a total of 2 pairs of holes).
2. Anchor one end of the copper wire using the holes at one end of the plastic pipe. To do this, poke approx. 200 mm of wire into one of the holes from the outside, and thread it back out the second hole.
3. Carefully wind approx. 40 turns of wire around the pipe keeping the other end of the wire free.
4. Cut this wire and secure the end using the same method as in step 2. *(Continued)*

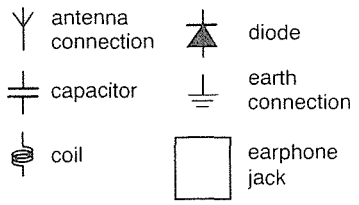


To make the crystal set board

1. Glue a copy of the crystal set plan to the rigid plastic.
2. Drill holes in the crossed circles.
3. Attach the earphone jack into the 6 mm hole, with the wiring connections to the underside of the board. One end of the diode goes under the earphone jack nut.
4. Insert the bolts from underneath the circuit board, with the washers and the nuts on the top of the board to hold wiring and components. Leave nuts loose until all wires to each bolt are attached.
5. Make all necessary connections to the three bolts on the top of the board, ensuring good contacts are made by having the copper wires stripped of their enamel. Ensure each wire goes around the bolt at least one turn.







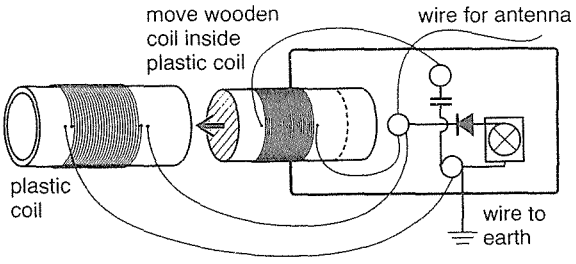
Note: Coil 1 (wooden) must go in the labelled position 1, and coil 2 (plastic) must go in position 2. Connect a short piece of wire from the earth bolt to the terminal on the earphone jack which connects to the tip of the earphone plug. Ensure a good connection by crimping the wire to the terminal with pliers, or by soldering.

To set up the crystal set

1. Use a long length of wire taped around your room as the antenna, if you are reasonably close to a transmitting station. If the station is further away, your antenna may need to be outside.
2. Set up an earth connection, either to a cold water pipe, or to a clean piece of copper pipe driven into a damp area of ground.
3. Listen very carefully to hear the faint radio signal. Adjust the relative positions of the coil to tune your crystal radio.

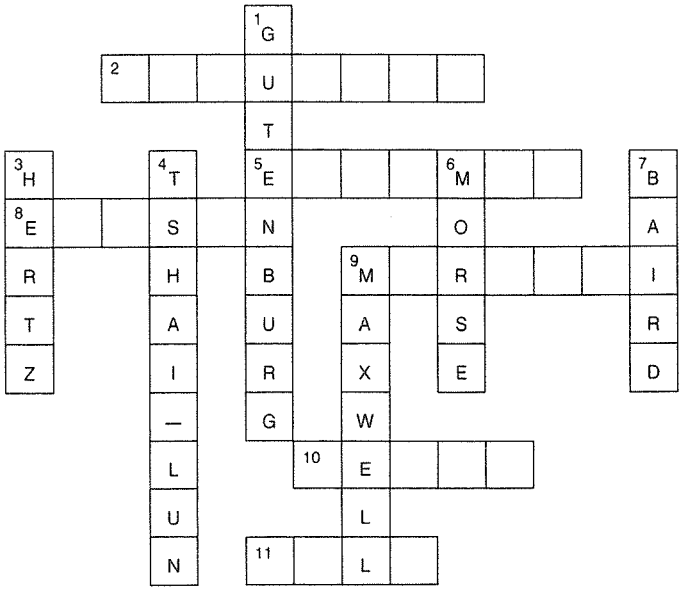
If your radio does not work:

- move the coils relative to one another to tune to a station;
- check all connections, especially the earphone jack, as on many models, only one of the three connecting holes is used;
- compare your construction to the circuit, and to the instructions given;
- check parts for physical damage;
- replace each part one at a time;
- ask a more experienced person for help.

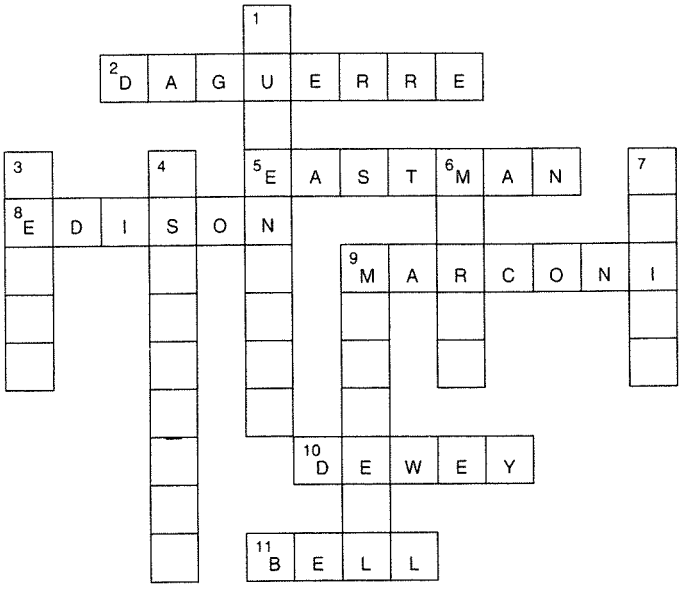


Barrier Crossword: People in communication

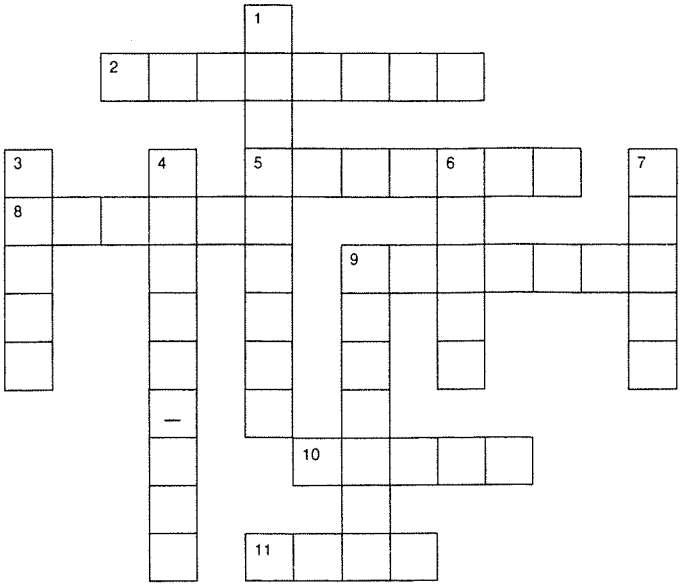
Down words



Across words



Traditional crossword: People in communication



Clues

Across

2. This person used silver-coated copper plates that had been treated with iodine vapour
5. This person introduced rolled film and a simple box camera in 1888
8. This person invented the carbon microphone
9. The first person to send a morse code message by radio
10. This person has a library system named after him
11. The telephone was invented by this person

Down

1. Books in Europe were handwritten until this person invented printing with movable type
3. This person constructed a transmitter and receiver
4. This person from China made paper from bark and bamboo in 105 A.D.
6. A code of dots and dashes is named after this person
7. In 1926 black and white television was first demonstrated by this Scotsman
9. During the 1800s this person predicted that unseen radiation existed

A different look at the stars

Special graphs called Hertzsprung–Russell diagrams are sometimes plotted to show information about stars. In this exercise, you are going to plot some stars on one of these graphs.

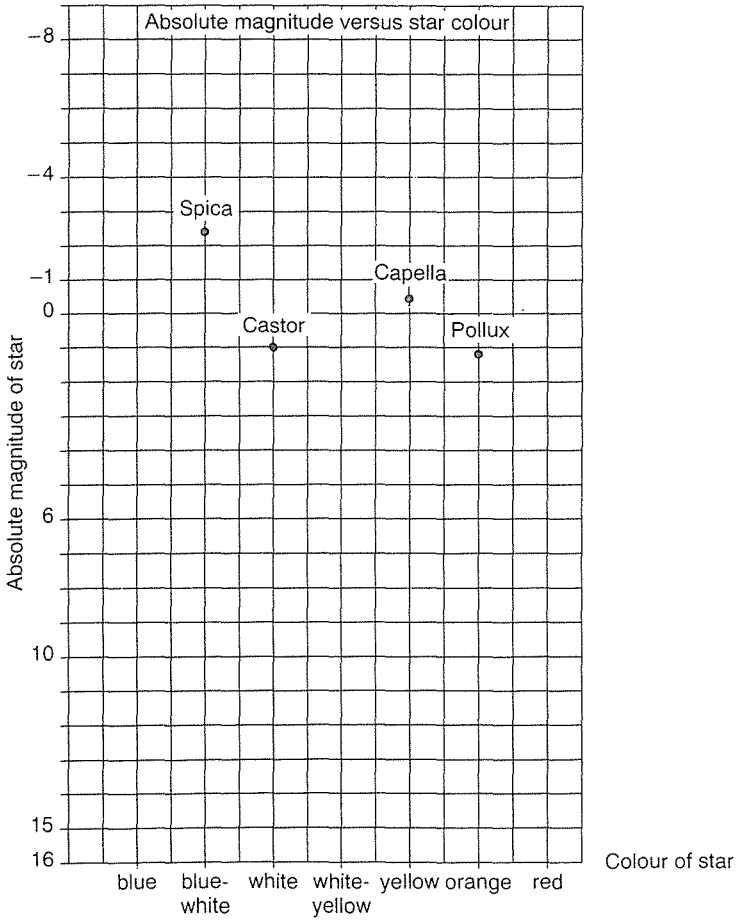
The information needed is summarised in the following table:

Star	*Colour*	*Magnitude*
Sun	yellow	+4.5
Vega	white	+0.5
Procyon	white-yellow	+2.5
Sirius	white	+1.5
Centauri	yellow	+3.5
Aldebaran	orange	−1.5
Arcturus	orange	−0.5
Antares	red	−5.0
Betelgeuse	red	−6.0

1. On the graph below, finish labelling the vertical axis using the absolute magnitude going from 16 at the bottom to −8 at the top. (Remember that the lower the magnitude, the brighter the star.)
2. Plot and label the points for each star, remembering to write the name of the star beside each point.
3. Use the star positions already plotted to work out the approximate colour and magnitude for: (a) Pollux (b) Capella (c) Spica (d) Castor

Research

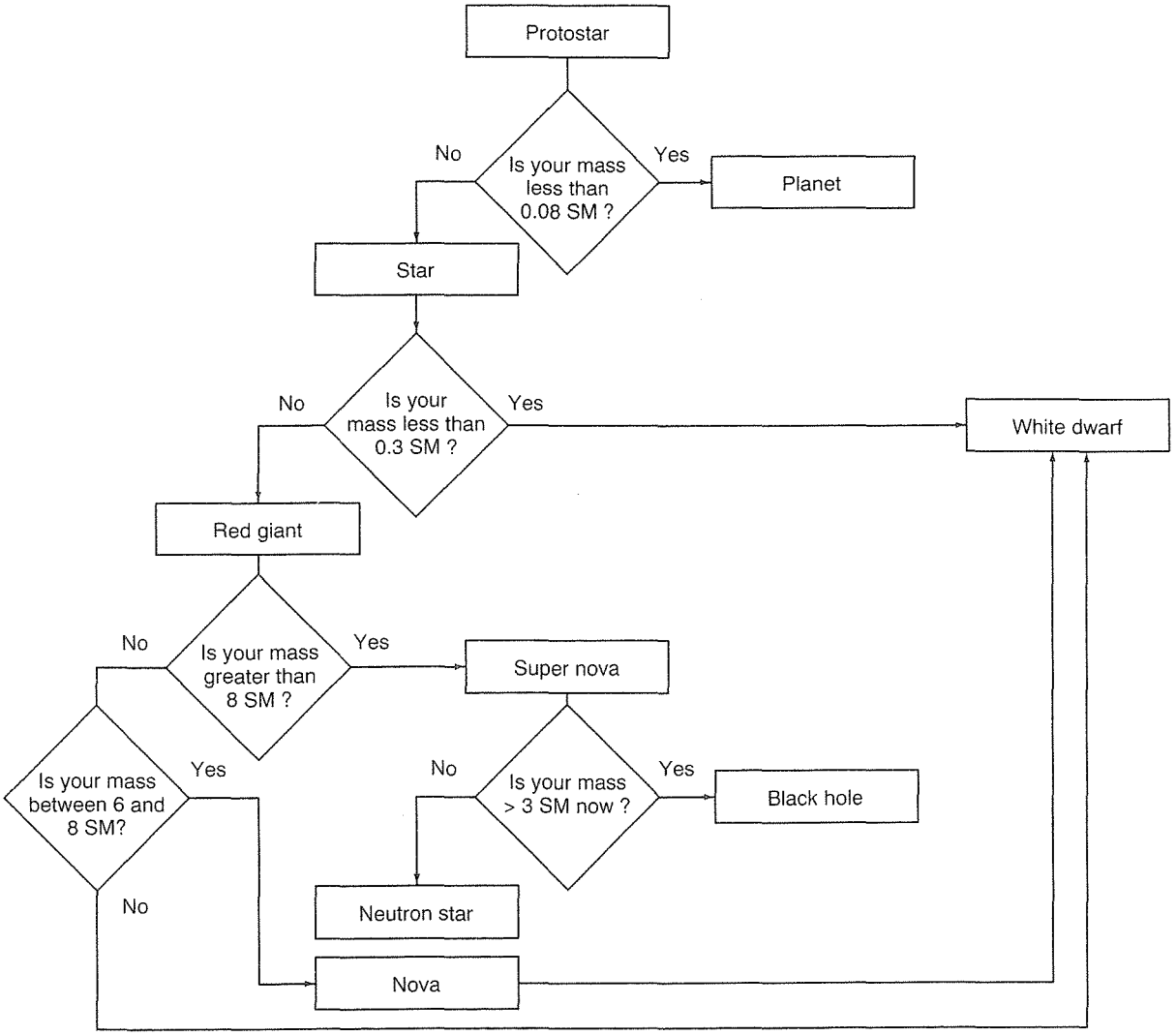
1. Other features usually plotted on Hertzsprung–Russell diagrams include the main sequence, red giants and white dwarfs. Find out what each of these features represents, and include them on your diagram. (Use a physics text that includes a chapter on astronomy to help.)
2. Many of the stars mentioned on this sheet are found in famous constellations. Find out which stars these are, and find the names of their constellations.



So you want to be a star... but which type?

Use the simplified flow chart to answer the questions that follow.

Note:
- SM in the flow chart means solar masses or the mass of the Sun.
- The life cycle of stars takes billions of years.



Questions

1. Would you become a star if you were made up of less than 0.08 solar masses of material? Explain your answer.
2. How does a massive star finish its life?
3. Which stars become red giants at some stage during their 'lifetime'?
4. What stages may a star have undergone before it became a neutron star?
5. What is the other common name given to a neutron star? (Use your text to help.)
6. What mass would a star that forms a nova be likely to have?
7. What do you think may become of matter that explodes from a supernova?

Extension work

Use the flow chart to design a game or poster to explain the lifecycle of a star to a Year 8 student.

Useful forensic science aids: cheque blank and dental records

WITCH Bank

YOUR TOWN, AUSTRALIA _____ 19

Pay _____ or bearer

the sum of _____

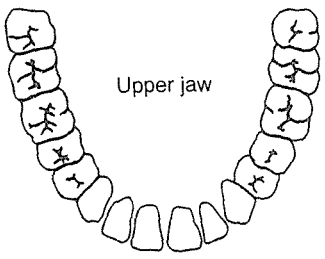
$ _____

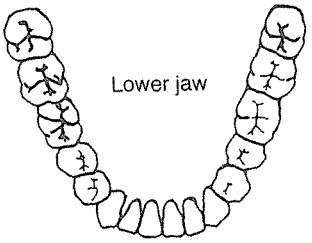
I. TRUSTU

⑆016 33 ⑈03 ⑉084⑆ 88⑉28 8⑈ SPECIMEN ONLY

Dental record

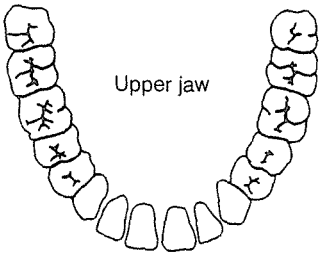
Name: _____

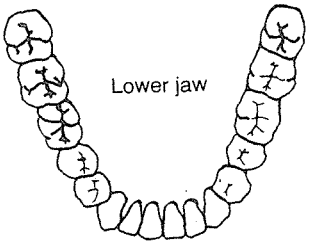




Dental record

Name: _____





BLM 38

Finger print sheet

Name: _____

1. Right thumb	2. Right index-finger	3. Right middle-finger	4. Right ring-finger	5. Right little-finger
10. Left little-finger	9. Left ring-finger	8. Left middle-finger	7. Left index-finger	6. Left thumb

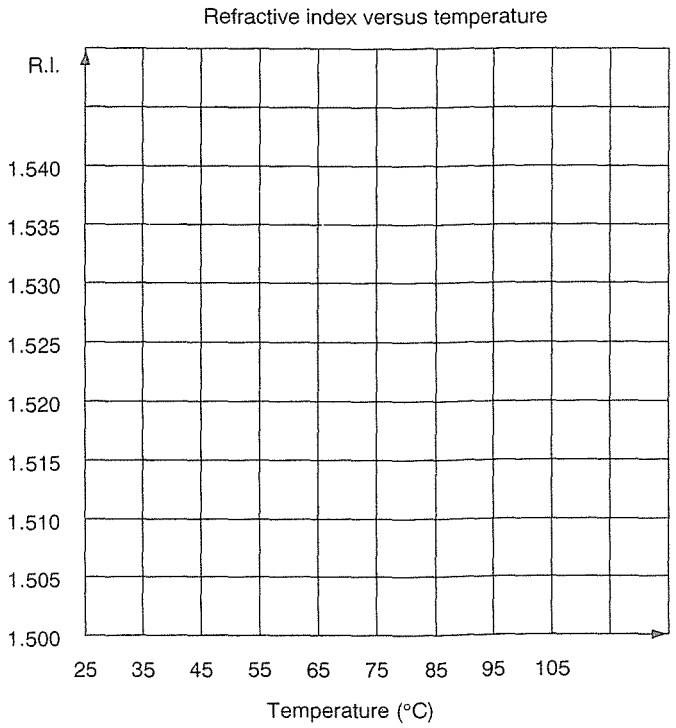
Left four fingers taken together	Right four fingers taken together
Left palm	Right palm

Refractive indices of glass

In Chapter 6 Option 3 Forensic science, you learnt that refractive indices may be experimentally determined by heating a sample of glass in oil, until the sample becomes invisible. The temperature at which the glass becomes invisible is related to the refractive index (R.I.) of the glass as you will see from the graph that you will now draw.

1. Use the following information to plot a refractive index versus temperature graph.

Temp of oil (T) (°C)	*Refractive index of glass* (R.I.)
25	1.534
35	1.530
45	1.526
55	1.523
65	1.520
75	1.516
85	1.513
95	1.509
100	1.507



2. Join the points on your graph with a straight line.

3. At what approximate temperature would you expect a sample of glass of refractive index:
   (a) 1.532
   (b) 1.515
   (c) 1.510
   to become invisible?

4. What would be the refractive indices for the following glass samples? The samples disappear at the following temperatures:
   (a) 40° C
   (b) 60° C
   (c) 70° C

5. Consider the following information:
   Some refractive indices are more common than others. For example, many samples of glass have refractive indices between 1.516 and 1.519, while few samples have indices above 1.532. Rarer types of glass may provide forensic investigators with evidence.
   - Glass from spectacles may have a refractive index of 1.523
   - Glass from many jars, bottles and head lights has a refractive index of approximately 1.516

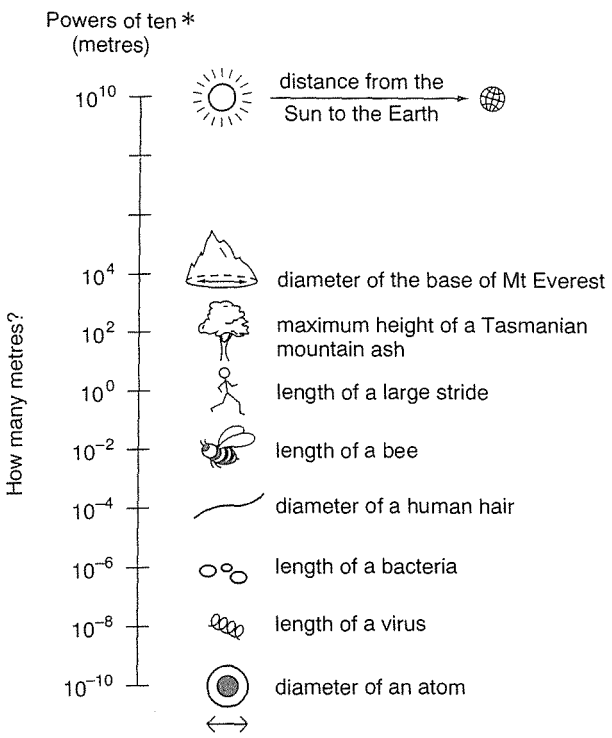
   Imagine that a crime investigator has found four different samples of glass at an accident scene. Refractive indices for each sample are:
   - sample A — 1.516
   - sample B — 1.535
   - sample C — 1.515
   - sample D — 1.523

   Would these readings be useful to the investigator? Explain your answer fully.

How big, how small, and units too

Powers of ten

You may need a calculator and you do need a knowledge of powers of ten for this Blackline master.



* *Note:* This diagram has a logarithmic scale

Given that distances between:

- 10^{3} m and 10^{-3} m may be seen with the unaided human eye
- 10^{-3} m and 10^{-6} m may be seen with a light microscope and
- 10^{-7} m and 10^{-10} m may be seen with an electron microscope answer the following questions.

1. Would you expect to be able to see a virus with:
   (a) the unaided human eye?
   (b) a light microscope?
   Explain your answers.
2. Write the following numbers as fractions:
   (a) 10^{-2} m
   (b) 10^{-6} m
   (c) 10^{-4} m
3. Powers of ten may be used to describe many measurements. For example, the length of a playing field is 100 m. One hundred metres may be expressed as 10^{2} m. Express the following lengths in metres, as powers of ten.
   (a) the height of an average adult male (approx. 2 m)
   (b) the length of a blacklead pencil (approx. 0.15 m)
   (c) the length of your classroom

Units

Prefixes help to remind us of powers of ten when we are taking measurements.

Small measurements:
- nano = 10^{-9}
- micro = 10^{-6} (or millionths)
- milli = 10^{-3} (or thousandths)
- centi = 10^{-2} (or hundredths)

Large measurements:
- kilo = 10^{3} (thousands)
- mega = 10^{6} (millions)
- giga = 10^{9}

Using the information about prefixes answer the following questions.

4. How many:
   (a) grams (g) are in a kilogram (kg)?
   (b) litres (L) of water are in a megalitre (ML)?
   (c) millimetres (mm) are there in 2 metres (m)?
5. How many:
   (a) millimetres (mm) are there in 36 centimetres (cm)?
   (b) tonnes (t) are there in 30 megatonnes (Mt)?
   (c) kilograms (kg) are there in 1 500 grams (g)?
   (d) milligrams (mg) are there in 2 kilograms (kg)?

Chapter 1: Topic test: Obtaining food

Do not write on this paper. Write all answers on other paper. You may need to use a calculator for this test.

Section A

Multiple-choice questions

1. Dried foods often keep for long periods of time because microbes cannot live in:
   (a) wet environments
   (b) dry environments
   (c) sealed packages
   (d) acidic conditions

Question 2 refers to the following information about food additives and their numbers.

Additive number	*What the number refers to*
100–181	• colours
200–297	• preservatives and some food acids
300–381	• antioxidants, some food acids and mineral salts
400–492	• vegetable gums, emulsifiers, stabilisers, some anti-caking agents, mineral salts and humectants
500–579	• more mineral salts and anti-caking agents
620–637	• flavour enhancers
900–1202	• miscellaneous additives

- Sulfites are used as preservatives.
- Propionates are used to stop microbe and fungal growth.
- Polyphosphates are used as stabilisers.
- Glutamates are used as flavour enhancers.
- Tartrazine is used as yellow colouring in foods.

2. From this information, it would be expected that the additive numbers for the listed substances would fall in the ranges:
   (a) sulfites 100–181 and polyphosphates 500–597
   (b) tartrazine 900–1202 and propionates 500–579
   (c) propionates 200–297 and glutamates 620–637
   (d) polyphosphates 100–181 and tartrazine 200–297

3. On a far-away planet, life forms reproduced according to Mendelian genetics. Triglia plants having either black or blue flowers, grew on this planet.

   The black genes (B) were dominant and the blue genes (b) were recessive.

   When two triglias having black flowers of the genotype Bb were crossed, the most likely percentages of each type of offspring were:

	% black flowers	*% blue flowers*
(a)	50	50
(b)	25	75
(c)	75	25
(d)	100	0

Question 4 refers to the following table.

Food, amount	*Total energy content* (kilojoule, kJ)
1 egg, boiled	303
1 egg, fried	374
bread, 1 slice (brown) toasted	271
muffin, 1 plain toasted	669
butter, 1 tablespoon	547
margarine, 1 tablespoon, polyunsaturated	539
orange juice (unsweetened), 1 glass	355
pineapple juice (unsweetened), 1 glass	488
coffee, black, 1 cup	6
tea, black, 1 cup	0
water, 1 glass	0

4. From the information in the table it would be true to say that a person trying to reduce their kilojoule intake would be best to:
   (a) drink a glass of pineapple juice rather than a glass of orange juice
   (b) drink a cup of black coffee rather than a cup of black tea
   (c) eat 2 muffins with 1 tablespoon of butter rather than 3 slices of brown toast with 1 tablespoon of margarine
   (d) eat a fried egg on a plain slice of brown toast rather than a muffin with margarine

(Continued)

5. Meoisis is a process which:
   (a) involves the formation of sex cells
   (b) occurs in all living cells, allowing growth and repair
   (c) involves the joining of sex cells
   (d) occurs in animals only (5 marks)

Section B

Short-answer questions

6. Imagine that you found a swollen tin of food in your pantry.
   (a) What may have caused the tin to swell?
   (b) Would the food be safe to eat? Explain your answer. (2 marks)

7. Food samples were being tested in the school laboratory, and the following results were obtained for three different foods:
   Food A: DCPIP went from blue to colourless
   Food B: Iodine solution went from a straw colour to blue-black
   Food C: Testape went from yellow to green
   List the nutrients which were present in foods A,B and C. (3 marks)

Section C

Longer questions

8. A farmer believed that a sheep and a goat on her farm had mated. She called the offspring geeps. What types of genetic information would she need to find out if the geeps were indeed offspring of these animals? (2 marks)

9. Write at least two sentences about the impact of the Industrial Revolution on food production. (2 marks)

10. (a) Describe one asexual method of reproduction in plants. (You may draw a labelled diagram as your answer.)
    (b) Compare the parent and its offspring when asexual reproduction has occurred. (3 marks)

11. In an example of incomplete dominance, a yellow flower was crossed with a red flower to produce an orange flower.
    Draw a Punnett square to determine what percentage of different coloured flowers are likely if two orange flowers are crossed. (3 marks)

Section D

Skills/experimental design

12. Design an experiment to determine which food—crumpets or thick white bread—stays fresher longer.
    Include in your answer:
    - an aim or a hypothesis
    - a method
    - a list of controls and variables used in your experiment
    - possible results (10 marks)

Total 30 marks

Chapter 2 Topic test: Staying healthy

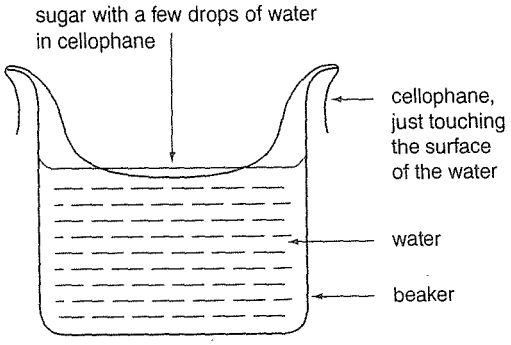
Do not write on this paper. Write all answers on other paper. You may need to use a calculator for this test.

Section A

Multiple-choice questions

1. Tooth decay occurs when:
   (a) bacteria contained in food stays in the mouth and sticks on the teeth
   (b) bacteria that occur naturally in the mouth multiply more quickly in the presence of certain foods
   (c) teeth naturally deteriorate with time
   (d) brushing and flossing are done regularly

2. The diagram shows an experiment set-up to model movement of materials across a cell membrane.

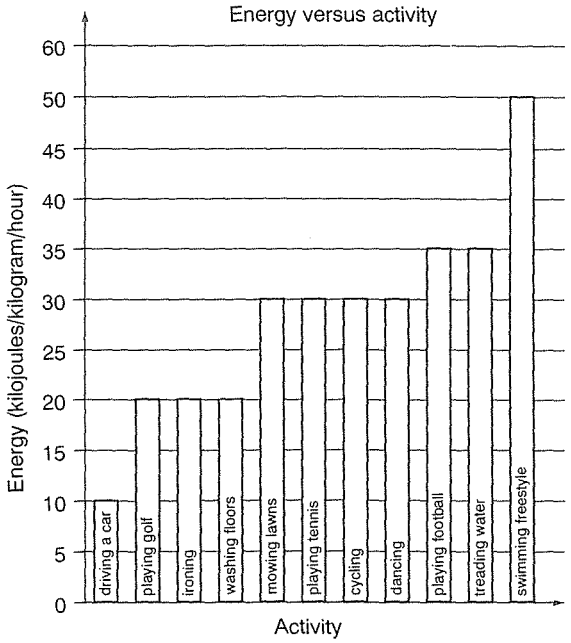


Some students discovered that, after a day, the water level in the cellophane was higher than the water in the beaker. They concluded that movement had occurred across the cellophane membrane because:

(a) water had moved from the less concentrated solution to the more concentrated solution
(b) water had moved from the more concentrated solution to the less concentrated solution
(c) the sugar had moved into the beaker forcing the water up into the cellophane
(d) the experiment was set up incorrectly

3. Microscopic structures called cilia are found in the respiratory system. They help to remove mucus and foreign bodies. Cilia may be destroyed:
   (a) during an asthma attack when they are drowned in mucus
   (b) during a hay fever attack when they become dry and break off
   (c) when they are continually exposed to cigarette smoke
   (d) when a person has a cold and continually coughs

4. The following chart indicates approximate energy usage for particular activities.



- Student X has a mass of 60kg, while
- Student Y has a mass of 50kg.

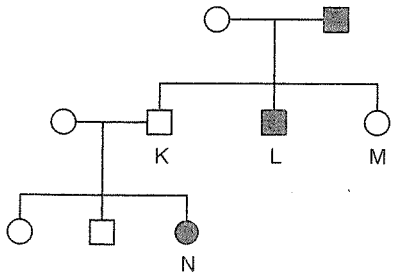
In which case would Student Y use up *more* energy than Student X?

Student X (60 kg)	*Student Y (50 kg)*
(a) cycled for 2 h	danced for 1½ h
(b) played golf for 3 h	played tennis for 1 h
(c) trod water for 1 h	drove a car for 3 h
(d) played football for 1 h	mowed for 2 h

(Continued)

5. Look at the following pedigree. The shaded shapes represent people who suffer from a particular genetic disorder. This disorder is not sex-linked and is recessive.

Which individuals in the pedigree may be carriers for the disorder? A carrier has a gene for the disorder but shows no symptoms of the disorder.



The individuals in the pedigree that may be carriers are:

(a) K and L
(b) K and M
(c) L and N
(d) M and N (5 marks)

Section B

Short-answer questions

6. (a) Many types of milk are currently available. What advantage/s would there be in drinking milk that is:
(i) low in fat?
(ii) high in calcium? (2 marks)
(b) Give two examples of disorders that may occur if children do not have enough milk and dairy products (or suitable replacements). (1 mark)

7. (a) Name two legal drugs that may cause health problems. (1 mark)
(b) For each of the drugs named in (a), give one example of its negative effects. (1 mark)

8. Business people are sometimes considered to be unhealthy.
(a) Which aspects of their lives may contribute to poor health?
(b) How could these people ensure that they keep fit? (3 marks)

9. (a) What types of pollution affect people's health?
(b) List two examples of health problems that may be caused by pollution. (2 marks)

Section C

Longer questions

10. The table provides information about the approximate percentage of deaths of males and females in particular age groups, caused by cardiovascular (heart) disease, in Australia.

*Age group** (years)	*% Females*	*% Males*
25–34	5	0
35–44	20	20
45–54	25	40
55–64	35	45
65–74	50	50
over 75	60	50

* *Note:* Under 24 years, the incidence of death from cardiovascular disease is not significant, at this time.

(a) Using this information, draw a column graph showing percentage of deaths versus age group.
(b) In which age group/s are:
(i) women most at risk?
(ii) men most at risk?
(c) What aspects of lifestyle are believed to increase the risk of cardiovascular disease? (5 marks)

Section D

Skills/experimental design

11. Children are often inattentive and unable to concentrate after lunch. One theory suggests that their inattentiveness may be caused by chocolate and sweets eaten as part of the midday meal.

Suggest a method that might be used to test the hypothesis. List any controls that you would need for your experiment. Remember to include possible results in your experimental report. (10 marks)

Total 30 marks

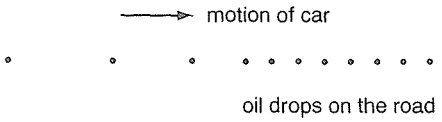
Chapter 3 Topic test: Motion

Do not write on this paper. Write all answers on other paper. You may need to use a calculator for this test.

Section A

Multiple-choice questions

1. The figure shows oil drips as a car moves slowly along the road. From the pattern of drips, it can be seen that the car:
   (a) sped up and then slowed down
   (b) sped up and then moved at a constant speed
   (c) slowed down and then sped up
   (d) slowed down and then moved at constant speed



2. Two students were discussing their weight on Earth and on the Moon.
   - Student A's mass was 54 kg while Student B's mass was 60 kg.
   - Lunar gravity is 1/6th of the gravity on Earth (Assume the Earth's gravity is taken to equal 10 ms^{-2})

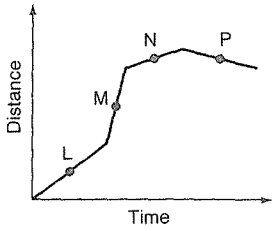
   Which of the following statements is true?
   (a) Student A will weigh 54 kg while Student B will weigh 60 kg on both the Moon and the Earth.
   (b) Student A will weigh 9 kg while Student B will weigh 10 kg on the Moon.
   (c) Student A will weigh 54 N while Student B will weigh 60 N on both the Moon and the Earth.
   (d) Student A will weigh 90 N while Student B will weigh 100 N on the Moon.

3. Students were investigating friction on different surfaces. They pulled a spring balance attached to a piece of wood across each surface. The forces needed to pull the wood are shown in the table.

Surface number	*Reading* (units)
R	43
S	19
T	5
U	27
V	12
W	48
X	6

From these results, it would be true to say that:
(a) surfaces R and W have the least friction
(b) surfaces T and X have the greatest friction
(c) surface W would have the least friction and would be the best surface for ice skating
(d) surface T has the least resistance to movement

4. The distance–time graph shows the motion of an object along a path. At which one of the following points was the object moving the fastest?
   (a) L
   (b) M
   (c) N
   (d) P



5. Given that momentum equals mass multiplied by velocity, which of the following has the greatest momentum?
   (a) a 30 kg dog moving at 2 ms^{-1}
   (b) a 50 kg person moving at 1 ms^{-1}
   (c) a 2 kg remote-controlled plane flying at 10 ms^{-1}
   (d) a 5 kg toy moving at 5 ms^{-1} (5 marks)

Section B

Short-answer questions

6. Children riding on horses on a merry-go-round feel as though they are being thrown outwards from the centre of the ride. What causes this feeling? (2 marks)
7. The Voyager spacecraft has no more fuel, but the craft continues to travel out past Pluto. Use Newton's law/s to explain why the spacecraft continues to move. (2 marks)
8. Many male swimmers shave their heads before major swimming competitions. Explain why a shaven head may be an advantage. (1 mark)

(Continued)

Section C

Longer questions

9. Terri and Kim measured the distance that a train moved over a period of several seconds. Their readings are given in the table:

Time (s)	0	1	2	3	4	5	6	7	8	9
Distance (m)	0	10	20	30	40	50	70	90	90	90

(a) Plot a distance versus time graph to display the results. Make a line graph by joining the points using straight lines. (5 marks)

(b) Find the average speed over the first 5 s. Show your working. (2 marks)

(c) Describe the motion of the train over the 9 s period. (3 marks)

Section D

Skills/experimental design

10. Golf balls have a dimpled surface to improve their performance. Imagine that you have designed the new *Sooper* golf ball. Final testing of the ball must be carried out, before stocks are sent out to sporting stores.

(a) What type/s of tests would you carry out on the *Sooper* ball? (Variables that may be considered include the forces that act on a golf ball during a game, the playing surface, and the type of club used.)

(b) List any controls that you need to use. (10 marks)

Total 30 marks

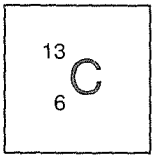
Chapter 4 Topic test: Holding matter together

Do not write on this paper. Write all answers on other paper.

Section A

Multiple-choice questions

1. Carbon-13 is a special form of the element carbon that is used to find the age of ancient objects. This form of carbon is sometimes represented by:



From this information, this form of carbon has:
(a) 13 electrons
(b) 13 neutrons
(c) 6 electrons
(d) 6 neutrons

2. This question refers to three substances *X*, *Y* and *Z*.
   - Substance *X* is shiny and conducts electricity in the solid state;
   - substance *Y* is made of crystals, and when *Y* is dissolved in water, the solution conducts electricity;
   - substance *Z* is a gas made up of one type of atom.

   From this information, it would be true to say that:

	X	*Y*	*Z*
(a)	• non-metallic element	• covalent compound	• metal
(b)	• covalent compound	• metal	• ionic compound
(c)	• metal	• ionic compound	• non-metallic element
(d)	• elemental compound	• mixture	• covalent compound

3. Which of the following is the correctly balanced equation for the reaction of solid magnesium hydroxide with sulfuric acid?

(a) $MgOH_{(s)} + H_2SO_{4(aq)} \longrightarrow MgSO_{4(aq)} + H_{2(g)}$
(b) $MgOH_{(s)} + H_2SO_{4(aq)} \longrightarrow MgSO_{4(aq)} + H_2O_{(l)}$
(c) $Mg(OH)_{2(s)} + H_2SO_{4(aq)} \longrightarrow MgSO_{4(aq)} + 2H_{2(g)}$
(d) $Mg(OH)_{2(s)} + H_2SO_{4(aq)} \longrightarrow MgSO_{4(aq)} + 2H_2O_{(l)}$

4. The correct name for the hydrocarbon compound that has six carbons in a straight chain and only one double bond is:
(a) hexane
(b) hexene
(c) heptane
(d) heptene

Question 5 uses the following information.
The solubility rules state that:
- all nitrates are soluble;
- all ammonium salts are soluble;
- all sodium and potassium salts are soluble;
- all salts of lead and silver, except the nitrates are insoluble (they do NOT dissolve);
- most hydroxides and carbonates are insoluble.

5. From these rules, it would be true to say that BOTH of the following substances would dissolve in water:
(a) zinc nitrate and ammonium carbonate
(b) lead nitrate and silver chloride
(c) silver carbonate and calcium hydroxide
(d) ammonium hydroxide and barium carbonate (5 marks)

Section B

Short-answer questions

6. The mass number of one form of chlorine is 37, while its atomic number is 17.
List the three subatomic particles, together with the numbers of each, that are present in this form of chlorine. (3 marks)

7. Draw a diagram to show a model of each of the following hydrocarbons:
(a) methane
(b) ethene (2 marks)

(Continued)

Section C

Longer questions

8. A student is supplied with the following chemicals:

solid magnesium
hydrochloric acid
aqueous potassium carbonate
solid magnesium oxide
sulfuric acid
solid zinc
nitric acid
aqueous potassium hydroxide

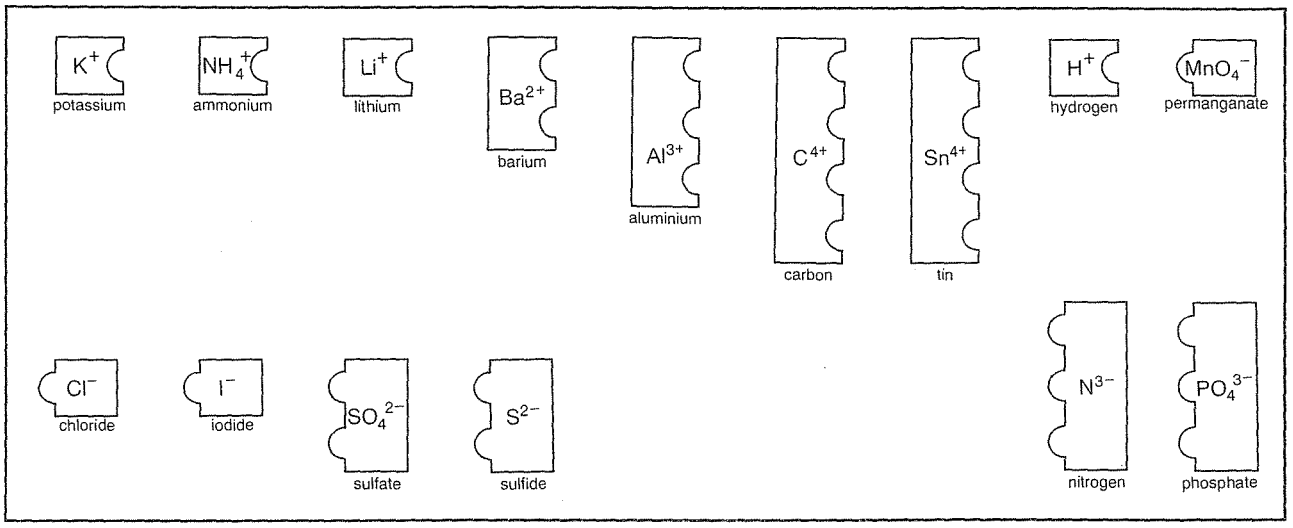
The following substances are to be made:

- liquid water
- aqueous magnesium chloride
- hydrogen gas

(a) Suggest reactions that would produce these substances. (A total of at least three reactions will be needed, and all of the substances will not be used. Some substances may be used more than once.) Suggest word equations for these reactions.

(b) Write balanced chemical equations for the reactions in part (a). (6 marks)

9. Given the following jigsaw pieces, work out the chemical formulas for the following substances:
   (a) potassium permanganate
   (b) ammonium phosphate
   (c) lithium sulfate
   (d) tin(IV) chloride
   (e) aluminium phosphate
   (f) carbon disulfide
   (g) ammonia
   (h) barium iodide



(4 marks)

Section D

Skills/experimental design

10. Design an experiment to compare the acidity of lemon juice and a dilute solution of a laboratory acid, say 0.5 M hydrochloric acid. Explain briefly how you would carry out your activity. Suggest results and the conclusion/s that you could draw from these results. (10 marks)

Total 30 marks

Chapter 5 Topic test: Geology in Australia

Do not write on this paper. Write all answers on other paper.

Section A

Multiple-choice questions

1. The ore magnesite is mainly:
   (a) magnesium oxide
   (b) magnesium hydroxide
   (c) magnesium carbonate
   (d) magnesium sulfate

2. Which of the following statements about opals is true?
   (a) Australia is the only country currently mining black opals
   (b) All opals are valuable
   (c) Traditional Aboriginal people had not seen opals until after European settlers arrived
   (d) Opals shine because the stones are cut with many facets

3. Part of the activity series of metals is reproduced here.

potassium — MOST REACTIVE
sodium
magnesium
aluminium
iron
lead
(hydrogen)*
copper
silver
gold
platinum — LEAST REACTIVE

* Hydrogen is not a metal, but is included to explain water and acid reactions.

From this information it would be easier to extract:
(a) aluminium from its ore than iron from its ore
(b) magnesium from its ore than silver from its ore
(c) potassium from its ore than gold
(d) lead from its ore than iron from its ore

4. This question refers to the table of densities for several metals that follows.

Metal	*Density* (g/cm^3)
aluminium	2.70
gold	19.30
iron	7.86
magnesium	1.74
tin	7.30
zinc	7.14

Abdul was given sheets of equal size and thickness of each of these metals. The sheets were not labelled in any way. The task was to work out which metal was which, based on density measurements alone. The most difficult metals to positively identify experimentally, on the basis of density alone, would be:
(a) gold and magnesium
(b) aluminium and magnesium
(c) zinc and tin
(d) tin and iron

5. This question refers to the table and paragraph that follows it.

Object	*Approximate hardness*
steel file	6.5
window glass or pocket knife blade	5.5
copper coin	3
fingernail	2.5

Rock W was not scratched by a pocket knife, but was scratched by the steel file.
Rock Y was not scratched by a fingernail, but was scratched by the copper coin.

From this information, it would be true to say:
(a) Rock W could be scratched by rock Y
(b) Rock Y could be scratched by rock W
(c) Rock W has a hardness between 2.5 and 3
(d) Rock Y has a hardness between 5.5 and 6.5

(5 marks)

Section B

Short-answer questions

6. (a) Where does the economically important magnesite deposit occur in Australia?
   (b) Name one place where opal is mined in Australia. (2 marks)

(Continued)

7. Another name for platinum is white gold. Using platinum's position in the activity series of metals (see Question 3), suggest a reason why platinum is used in jewellery manufacture. (1 mark)

8. The following list includes some of the ingredients in 'Big Eyes' eyeshadow: talc, mineral oil, zinc stearate, iron oxides, bismuth oxychloride, magnesium carbonate, mica and titanium dioxide.
   - Green colour may contain chromium hydroxide and chromium oxides.
   - Blue colour may contain iron(III) ferrocyanide.

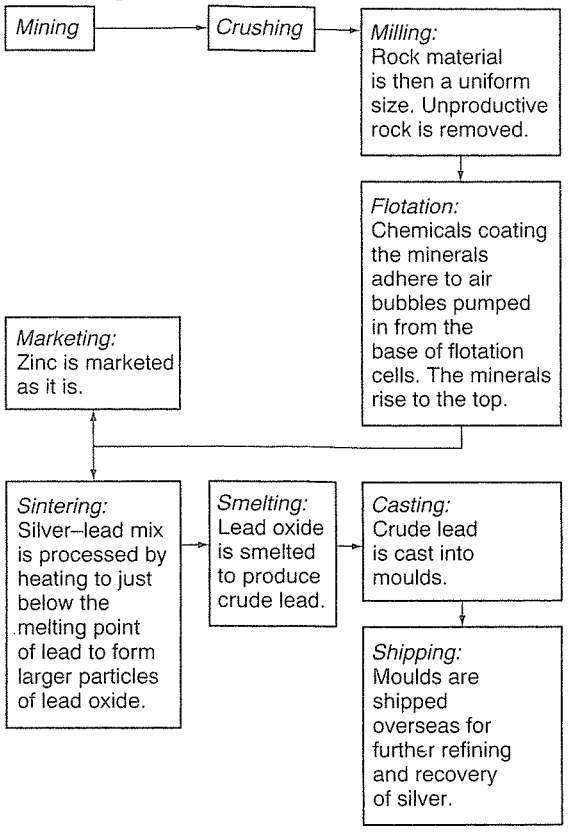
   Which of the ingredients is/are:
   (a) one of the minerals in Mohs scale of hardness?
   (b) a mineral that splits into sheets easily?
   (c) responsible for blue colour?
   (d) responsible for green colour?

   (4 × ½ = 2 marks)

Section C

Longer questions

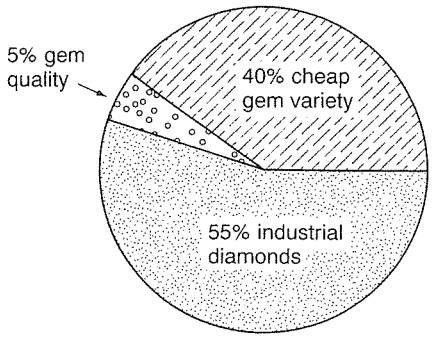
The following flow chart shows how silver/zinc/lead ores are handled at Mt Isa. Use the flow chart to answer question 9.



9. (a) During which stage of the ore handling:
   (i) does the lead become lead oxide?
   (ii) do air bubbles force minerals to rise to the surface?
   (iii) is the silver recovered?
   (iv) is the unproductive rock removed?
   (b) Do you think that the zinc obtained using this process would be pure? Explain your answer. (6 marks)

Use the following information about the Argyle diamond mine to answer questions 10 and 11.

The Argyle diamond mine, in the Kimberley region of Western Australia, is the world's biggest diamond producing mine. It is also the only mine producing highly prized deep pink diamonds. The quality of diamonds from the mine is shown in the pie chart.



Note: Only seven carats of diamonds are produced from every tonne of ore.

10. Why is the Argyle diamond mine important? (2 marks)
11. According to the pie chart, what type of diamonds make up the:
    (a) largest percentage?
    (b) smallest percentage? (2 marks)

Section D

Skills/experimental design

12. Imagine that you are the detective in charge of a criminal investigation related to stolen champagne diamonds. Luke Steel is the prime suspect because he has been found with beautiful stones in his possession. Luke maintains that these stones are simply cut glass, and have no value.

    You suspect that they are indeed the stolen champagne diamonds.
    (a) Design an experiment to check Luke's story.
    (b) Suggest possible results and the conclusions that would be drawn from them.

    Note: You have a Mohs scale of hardness kit of minerals, together with the scale.

Mohs scale of hardness

1.	talc	6.	orthoclase
2.	gypsum	7.	quartz
3.	calcite	8.	topaz
4.	fluorite	9.	corundum
5.	apatite	10.	diamond
5.5.	window glass		

(10 marks)

Total 30 marks

Chapter 6: Option I Topic test: Communication

Do not write on this paper. Write all answers on other paper. You will need a calculator to help with one question.

Section A

Multiple-choice questions

1. Radio waves are a form of electromagnetic radiation.
   - They travel at 300 000 km/s.
   - The distance from the Earth to the Moon is approximately 380 000 km.

   This information means that a signal sent to the Moon *and* reflected back to the Earth would take approximately:
   (a) 5 s
   (b) 2.5 s
   (c) 1.25 s
   (d) 0 s since radio waves travel at the speed of light.

Questions 2 and 3 rely upon the morse code:

A .-	G --.	L .-..	Q --.-	V ...-
B -...	H	M --	R .-.	W .--
C -.-.	I ..	N -.	S ...	X -..-
D -..	J .---	O ---	T -	Y -.--
E .	K -.-	P .--.	U ..-	Z --..
F ..-.				

Note: The messages in questions 2 and 3 do not contain punctuation.

2. The correct morse code for the word 'communication' is:
   (a) -.-. --- -- -- ..- -. .. -.-. .- - .. --- -.
   (b) -.-. --- -- -- .- -. . -.-. .- - . --- -.
   (c) -.-. -- -- --- ..- -. .. -.-. .- - .. -.- .
   (d) -.- -- -- -- ..- -. ... --- .- - . --- -.

3. Consider the message:

   - .... . -.-. --- -.. . .... .- ... -.. --- - ... .- -. -.. --- -.. .- ... .

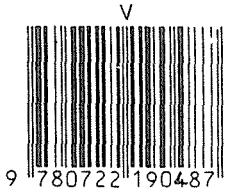
   The correct interpretation for the message is:
   (a) the code uses dots and dashes
   (b) this code uses dashes and dots
   (c) the code has dots and dashes
   (d) there are dashes and dots

4. In bar codes:
   - the first two numbers show the country where the bar code was issued;
   - the next five numbers provide information about the manufacturer;
   - the next five numbers describe the product; and
   - the final number checks if the code is correct.

   Which bar codes U, V, W and X show that the products are made by the same manufacturer in the same country?

U

V



W

X

   (a) U and V
   (b) V and W
   (c) X and U
   (d) W and X

5. The main advantage of geostationary satellites is that:
   (a) the fuel costs are low because they do not move, once in orbit
   (b) only three satellites are needed to cover the Earth's surface
   (c) these satellites orbit about 100 km above the Earth, so cost of radio transmissions is low
   (d) these satellites specialise in geological data

(5 marks)

(Continued)

Section B

Shorter questions

6. Name the form of communication that was:
   (a) invented by Guglielmo Marconi
   (b) used first—the telegraph or the telephone
   (1 mark)

7. Computer discs are a useful method for storing large amounts of information. Give two disadvantages of using these discs for data storage. (2 marks)

8. Which system is usually used to classify non-fiction books in a library? Briefly explain how the system operates. (2 marks)

Section C

Longer questions

9. Traditional American Indians used smoke signals to communicate with each other. Imagine that you have the perfect smoke column rising up from a safe fire (in the middle of winter).

   Devise a simple code to use your smoke as a signalling device. (5 marks)

Total 15 marks

Chapter 6: Option 2 Topic test: The universe

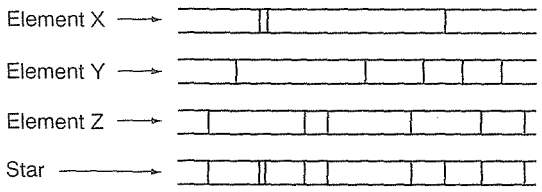
Do not write on this paper. Write all answers on other paper.

Section A

Multiple-choice questions

1. The Greeks, Aristotle and Ptolemy, had a different view of the universe to the Austrian monk Copernicus.
   (a) The Greeks believed that the Sun was at the centre of the universe
   (b) The Greeks believed that all celestial objects circled the Earth
   (c) Copernicus believed that the Earth was at the centre of the universe
   (d) Copernicus believed that the heavens were held up by air.

2. The spectra of three elements, as well as the spectra of a imaginary star, are given.



   From the spectra given, the star contains the elements:
   (a) X and Y
   (b) Y and Z
   (c) X and Z
   (d) X, Y and Z

3. A star such as our Sun will most probably end its life as:
   (a) a super nova
   (b) a nova
   (c) a black hole
   (d) a dwarf

4. The following table gives the magnitude for several stars:

Star	L	M	N	P	Q
Magnitude	1.0	2.5	6.0	1.5	5.0

   Which of the following statements about stars L, M, N, P and Q is true?
   (a) Star N is the brightest and would be visible even in a city at night.
   (b) Stars L, M and P could be seen in the city at night.
   (c) Star M is 100 times brighter than star P.
   (d) Star L is the least bright of these stars and would be difficult to see with a telescope.

5. Use the following table, together with other information that you have learnt during this option, to answer the following question.

Colour	*Surface temperature (approximate)* (Kelvin)
blue	30 000
white	15 000
yellow	6 000
orange	4 500
red	3 500

   Which of the following statements is true?
   (a) The Sun has a surface temperature of approximately 4 500 Kelvin.
   (b) The red giant Rigel has a surface temperature of 3 500 Kelvin.
   (c) The largest stars have the highest temperatures.
   (d) Stars become blue-white as they grow older.
   (5 marks)

Section B

Short-answer questions

6. Briefly describe the two main theories related to the origin of the universe. (4 marks)
7. Why is space travel likely to become more important as time goes on? (1 mark)

Section C

Longer question

8. Imagine that you are the commander of the Exit-Earth spacecraft, known as E-E. You are to colonise the New Planet known as N-P 11 in the Andromeda galaxy.
   Using the information in the table and your general knowledge of astronomy, answer the questions that follow.

Characteristics of N-P 11 compared to Earth.

Characteristic	N-P 11	*Earth*
Diameter	7 000 km	12 756 km
Distance to nearest star	250 million km	150 million km
Number of moons	3	1
Length of day	36 hours	24 hours
Length of year	3 Earth years	1 Earth year
Tilt of axis	23.5°	23.5°

   (a) Would you expect N-P 11 to experience seasons? Explain your answer. (2 marks)
   (b) Assuming that both the Earth and N-P 11 orbit similar stars, which planet (N-P 11 or Earth) would have a warmer climate? Explain your answer. (2 marks)
   (c) Describe the possible appearance of the night sky on NP-11 to the crew of E-E. (1 mark)

Total 15 marks

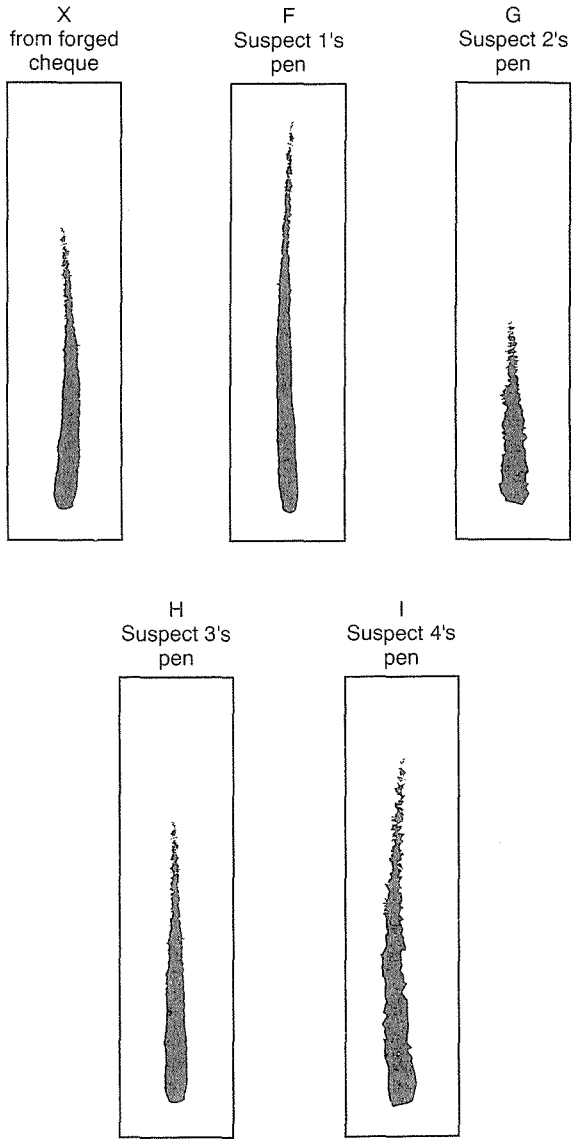
Chapter 6: Option 3 Topic test: Forensic science

Do not write on this paper. Write all answers on other paper.

Section A

Multiple-choice questions

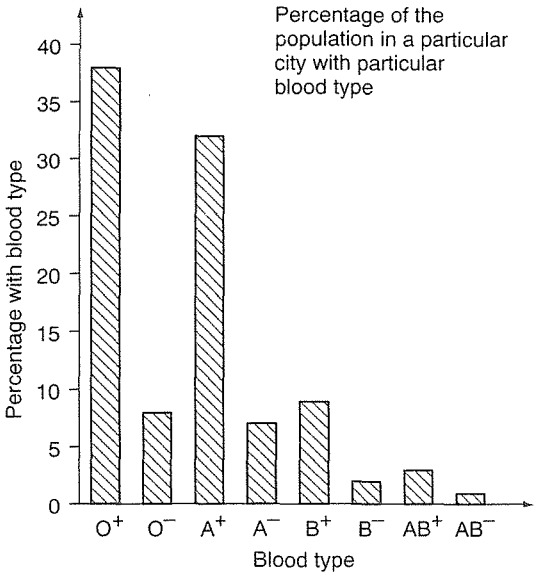
1. The strips of chromatography paper F, G, H and I, show the results from ink samples taken from the pens belonging to four suspects. Strip X shows the ink sample from the forged part of the cheque.



Which pen was used for the forgery?

(a) F
(b) G
(c) H
(d) I

2. A crime has been committed and several suspects have been brought in. The investigating detective has information about:
   - the percentages of different blood types in the city
   - the blood type at the scene of the crime
   - the suspects' and victim's blood type



Blood types:
AB^+ found at the scene of the crime
AB^+ victim's blood type
AB^+ suspect number 4's blood type
O^+ suspect number 1's blood type
A^+ suspect number 2's blood type
B^+ suspect number 3's blood type

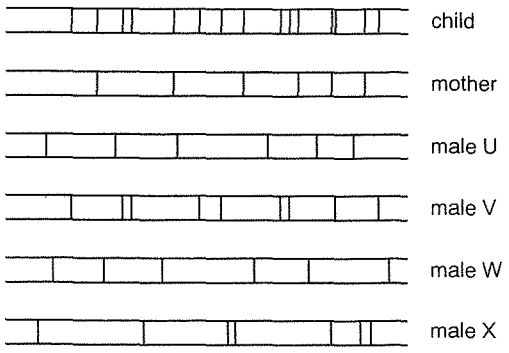
Based on the available evidence, which course of action would be the best to take?

(a) Suspect 1 should be arrested because O^+ is the most common blood group.
(b) Suspects 2 and 3 should be reinterviewed, and their blood type retested.
(c) Suspect 4 should be arrested because the blood type matches that at the scene of the crime.
(d) No arrest should be made because there is insufficent evidence.

(Continued)

3. Which of the following statements about fingerprints is true?
   (a) Fingerprints may be removed surgically so that no trace of them remains.
   (b) Fingerprints form about six months after a baby is born.
   (c) Fingerprints of identical twins are identical.
   (d) Fingerprints are different for every single person.

4. The DNA records of a child, its mother and four men had been dropped on the floor. Which of the code records is most likely to be that of the child's father?



   (a) U
   (b) V
   (c) W
   (d) X

5. Imagine that a skeleton has been found. The best method to discover its identity would be to use:
   (a) fingerprints
   (b) shoe size
   (c) dental records
   (d) bone structure

Section B

Short-answer questions

6. Imagine that you find a cricket ball near a broken window.
   (a) What observation/s can you make?
   (b) What inference might you make? (2 marks)

7. Forensic methods may be used to study past lifeforms. Suggest a reason why dinosaur footprints are found more often than dinosaur bones. (1 mark)

8. The use of people's irises (coloured part of the eye) is being considered as a means of identification, particularly at automatic teller machines. Explain why this method might be better than PIN (Personal Identification Number) numbers. (1 mark)

9. Evidence of the poison arsenic has been found in Napoleon's hair. At the time Napoleon lived, compounds of arsenic were used for many things, including pigment in wall paper.
   Could Napoleon have been poisoned? Explain your answer. (1 mark)

Section C

Longer questions

10. Imagine that a house has been robbed. The thieves have gained entry by breaking a window to reach the door handle. They have then left the premises, taking the stolen electrical goods through the garden.
    (a) List at least three clues that the thieves may have left behind. (3 marks)
    (b) Describe briefly how one of these clues may be used as evidence and kept as a permanent record for police files. (2 marks)

Total 15 marks

Practical exam: Work cards

Activity 1: Density of a cube

Given that density equals mass divided by volume, find the density of one of the cubes provided. Show all calculations.

You are provided with a ruler, a multiple-arm beam balance, a measuring cylinder and water.

Activity 2: What gas is that?

Your task is to determine which gas is produced in a particular reaction.

You are provided with a test tube containing a white powder, and a clear, colourless liquid that is to be added to the powder. About 2 cm height *only* of the liquid should be carefully added to the test tube. You are also provided with matches and a wax taper to test the gas produced. The experiment is to be carried out over a heat mat.

When you have completed the gas test, carefully pour the contents down the sink, wash the test tube and replace the clean test tube in the rack.

Activity 3: Who 'dunnit'?

Your task is to determine who may have stolen the money box from Kim Savit's room.

You are provided with a copy of the following people's fingerprints: Kim, Kim's trustworthy flatmate, Suspect 1 and Suspect 2.

SET A

Kim

Kim's flatmate

Suspect 1

Suspect 2

Moneybox prints

Activity 3: Who 'dunnit'?

Your task is to determine who may have stolen the money box from Kim Savit's room.

You are provided with a copy of the following people's fingerprints: Kim, Kim's trustworthy flatmate, Suspect X and Suspect Y.

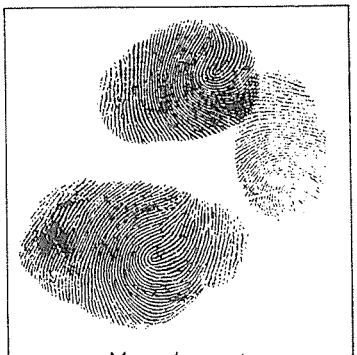
SET B

Kim

Kim's flatmate

Suspect Y

Suspect X



Moneybox prints

(Continued)

Activity 4: Microscopic evidence

You have a selection of slides containing vital evidence. Your task is to set up a microscope using *one only* of the labelled slides, and to sketch that slide.

Remember you *must* remove the slide and defocus the microscope when you have finished.

You are provided with a microscope, a microscope lamp and several prepared slides from which you choose only one.

Activity 5: Modelling organic compounds

Your task is to draw two possible arrangements of atoms for the compound butane, C_4H_{10}.

You are provided with a molecular model kit to help you to make up and then draw your models. You are to make two models.

Activity 6: Hardness and streak

Your task is determine the hardness and streak of two rock samples.

You are provided with a selection of rocks, from which you choose two. Record the number of each of the samples chosen, and using either the Mohs scale of hardness kit, or other materials of known hardness, determine the hardness of each sample. Use a white tile to determine the streak of each sample.

Practical exam: Answer sheet

Name: _____

Class: _____

Rules:

- There are 5 minutes allowed for each activity.
- There must be absolute silence.
- You must move to the next activity when told to do so.
- You will be allocated an activity on which to start. You will then move to the next activity. (For example, if you start on Activity 3, your next activity will be Activity 4.)
- Follow instructions. Do not do extra work because you may run out of time.
- Clean up during the 5 minutes. Marks will be deducted if you do not leave the activity as you found it.

Activity 1: Density of a cube

Record all necessary readings. Remember to repeat the activity to check for accuracy.

Working space:

Mass of cube no. = _____
Volume of cube no. = _____
Density of cube no. = _____

Activity 2: What gas is that?

Observations:

Name of gas produced:

Possible nature of:
(a) the powder

(b) the clear, colourless liquid

Activity 3: Who 'dunnit'?

Set of prints used:
Observations of prints:
(Include the order in which the prints were made on the money box)

Possible thief:

Reason for your choice:

(Continued)

Activity 4: Microscopic evidence

Slide used:

Magnification used:

Drawing of material observed:

Activity 5: Modelling organic compounds

2 drawings of possible structures of butane (C_4H_{10}).

Activity 6: Hardness and streak

Sample number: _____

Hardness: _____

Streak: _____

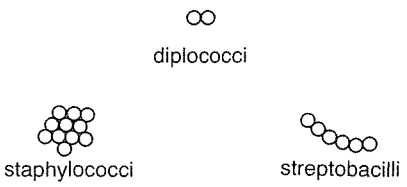
Sample number: _____

Hardness: _____

Streak: _____

Answers to Blackline masters

BLM 3: What are bacteria like?

1. (a) (i) Bacteria are similar to plant cells because both have cell walls and bacteria may have chlorophyll present.
   (ii) The lack of vacuoles in bacteria makes them similar to animal cells.
   (b) (i) The cell wall of a bacterium does not extend to form other cells as it does in plant cells.
   (ii) The possible presence of chlorophyll and the existence of a cell wall makes a bacterium different to an animal cell.
2. A bacterium differs from both plant and animal cells because it has no nuclear membrane.
3. 

4. tetrobacillus

BLM 4: Breakfast, the most important meal of the day?

1. (a) 45g (b) 30g
2. (a) muesli C
   (b) muesli B
   (c) wheat cereal
   (d) muesli B
3. Dried fruits and nuts are included in mueslis, and these have a high natural sugar content.
4. muesli B
5. Muesli A has the largest amount of vitamins present even after serving size is taken into account.
6. Students may say yes or no in answer to this question, and give a variety of reasons to support their conclusion. It would be useful to have a class discussion related to the importance of breakfast.

BLM 5: Mitosis

1. A. nucleus B. cytoplasm C. membrane
2. (a) 8 (b) yes
3. 16
4. 8
5. 8
6. 8
7. yes
8. There are the same number of chromosomes present in each cell of an organism (except in sex cells, red blood cells and during cell division).

   Stages of mitosis:
   Possible order of cells: (b), (a), (e), (d), (c)

BLM 7: Punnett puzzles

Section A

1. (a) tall (b) round (c) yellow (d) mauve
2. (a) TT × tt = all Tt
   (b) RR × rr = all Rr
   (c) Rr × Rr

   Note: Not all Punnett squares are shown for Question 2.

	R	r
R	RR	Rr
r	Rr	rr

   (d) yy × YY = all Yy
   (e) MM × mm = all Mm
   (f) Mm × Mm

	M	m
M	MM	Mm
m	Mm	mm

3. (a) all hybrid tall (100%)
   (b) all hybrid round (100%)
   (c) 1 pure round:2 hybrid round:1 pure wrinkled or 3 round:1 wrinkled or 75% round:25% wrinkled
   (d) all hybrid yellow (100%)
   (e) all hybrid mauve (100%)
   (f) 1 pure mauve:2 hybrid mauve:1 pure white or 3 mauve:1 white or 75% mauve:25% white

Section B

1. (a)

	T	X
T	TT	TX
X	TX	XX

   (b) The offspring would be in the ratio of:
   1 tall:2 middle-sized:1 short
2. (a) short hair
   (b) Let short be S, and long be s, then Ss × ss

	S	s
s	Ss	ss
s	Ss	ss

According to the Punnett square half or 50% or 2 of the offspring will have long (ss) hair. The other 2 would have hybrid short.

BLM 12: Allergic asthma

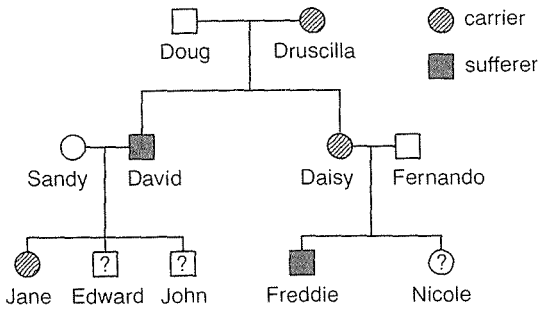
1. allergen (n): a substance to which the body is extremely sensitive, or to which the body has an allergic reaction.
2. Allergens such as pet fur, house dust and pollens may be found in a normal household. Allergens are often:
   - present for extended lengths of time, and
   - too small for the body to filter out and remove.
3. The allergen must be avoided, to minimise its effects. The asthmatic allergic to pet fur, may be unable to have pets in his/her household. Carpets and drapes may need to be kept to a minimum if dust mites are a problem, and so on.
4. Tartrazines and metabisulfites may cause problems for some asthmatics.
5. Tartrazine is a yellow dye found in foods such as fruit juices and desserts.
   Metabisulfite is a synthetic preservative that is sometimes added to dried vegetables, dried apricots, sausages and cordials.
6. Tartrazine is a yellow dye added to colour foods and drink.
   Metabisulfite is a synthetic preservative that stops food discolouring and bacteria growing.
7. (a) Food additive numbers are numbers that have been assigned to both synthetic and naturally-occurring chemicals, that are found in foods.
   (b) These numbers are found on the containers and packages in which food is sold.
   (c) These numbers tell people which chemicals are present in items of food, thus enabling sensitive people to avoid particular foods.

BLM 13: Stress: What do you know about it?

1. Symptoms of stress may include increased heartbeat and blood pressure, increased breathing rate, upset stomach, tension in muscles, headaches, and increased levels of adrenaline.
2. Positive situations may include being in a race that it is possible to win, enjoying a scary ride at a fun park, and producing a good assignment. Negative stress may include worry about family problems, possible failure at exams, and anxiety.
3. Noradrenaline is a hormone that causes veins and arteries to become narrower, as well as increasing the heartbeat.
4. It is unlikely that the cigarettes or alcohol do relax them. They probably feel better because they have had to sit down to smoke or drink. The psychological effects also probably help.
5. Lack of concentration could cause this tendency.
6. This answer will depend upon the individual.

BLM 14: Haemophilia and the royal families of Europe

1. Queen Victoria's affected children were Alice of Hesse and Beatrice, who were carriers, and Leopold who was a sufferer.
2. The mothers who were carriers were: Queen Victoria, her daughters Alice of Hesse and Beatrice, Alice's daughters Irene and Alexandria, and Beatrice's daughter Victoria, and Queen Victoria's son Leopold's daughter Alice.
3. (a) There were 7 female carriers out of the family tree with 27 females, so the percentage was $7/27 \times 100 = 25.9\%$ (assuming that the unknown females were not carriers).
   (b) There were 11 male haemophiliacs in the family tree, out of a total of 35 males, so the percentage was $11/35 \times 100 = 31.4\%$ (assuming that the unknown males were not haemophiliacs).
4. The royal families belonged to England, Spain, Russia and Prussia.
5. If Mary of Teck had been a carrier, George VI may have then been a haemophiliac, and if he had lived long enough to father his daughters, then they in turn may have been carriers.
6. (a)



   (b) The chances of:
      (i) Edward being a sufferer are zero, as the disorder is sex-linked and Sandy is not a carrier;
      (ii) Nicole being a carrier are 1 in 2 or 50%.
7. Intermarriage between close family members increases the chances of defective genes becoming dominant, and thus increases the chances of congenital diseases.

BLM 18: Motion equations

Equation in words	*Equation in symbols*	*Unit used for quantity on left-hand side (abbreviation)*
Newton's second law: force equals mass times acceleration	$F = ma$	newton (N)
average velocity = total distance/total time	$v_{av} = \frac{s}{t}$	metre per second (ms^{-1})
acceleration equals change in velocity divided by time	$a = \frac{v - u}{t}$	metre per second^2 (ms^{-2})
momentum equals mass times velocity	$p = mv$	kilogram metre per second ($kgms^{-1}$)
work done	$W = Fs$	joule (J)
kinetic energy	$KE = \frac{1}{2} mv^2$	joule (J)
gravitational potential energy	$GPE = mgh$	joule (J)

1. $F = m \times a$
   $= 7\text{ kg} \times 8\text{ ms}^{-2}$
   $F = 56$ N
   The force was 56 N.

2. $W = F \times s$
   $= 6\text{ N} \times 6\text{ m}$
   $W = 36$ J
   The work done was 36 J.

3. GPH $= m \times g \times h$
   $= 3\text{ kg} \times 10\text{ ms}^{-2} \times 60\text{ m}$
   GPH = 1800 J
   The gravitational potential energy was 1800 J or 1.8 kJ.

4. $KE = \frac{1}{2} \times m \times v^2$
   $= \frac{1}{2} \times 5\text{ kg} \times (24\text{ ms}^{-1})^2$
   KE = 1440 J
   The kinetic energy was 1440 J or 1.44 kJ.

5. $p = m \times v$
   $= 1.5\text{ kg} \times 3\text{ ms}^{-1}$
   $p = 4.5\text{ kgms}^{-1}$
   The momentum was 4.5 $kgms^{-1}$.

6. $v_{av} = s/t$
   $= 60\text{ m}/15\text{ s}$
   $v_{av} = 4\text{ ms}^{-1}$
   The average velocity was 4 ms^{-1}.

7. $a = \frac{v - u}{t}$
   $= \frac{(2 - 0.5)\text{ ms}^{-1}}{10\text{ s}}$
   $a = 0.15\text{ ms}^{-2}$
   The toy train's acceleration was 0.15 ms^{-2}.

8. $KE = \frac{1}{2} \times m \times v^2$
   $= \frac{1}{2} \times 2000 \times (6\text{ ms}^{-1})^2$
   KE = 36 000 J or 36 kJ
   The truck would have 36 000 J of kinetic energy.

9. Since average velocity equals distance over time, then distance will equal velocity multiplied by time.
   so $s = v \times t$
   $= 10\text{ ms}^{-1} \times 14\text{ s}$
   $s = 140$ m
   The object would have travelled 140 m.

10. Since $p = m \times v$, then $v = p/m$
    $= 156\text{ kgms}^{-1}/12\text{ kg}$
    $v = 13\text{ ms}^{-1}$
    The velocity of the object was 13 ms^{-1}.

BLM 20: Measuring motion

1. Units of distance: metre (m)
   time: second (s)
   speed: metre per second (ms^{-1})
   acceleration: metre per second squared (ms^{-2})

2. The equation used to calculate:
   (a) average speed $v_{av} = s/t$
   (b) acceleration $a = \frac{v - u}{t}$

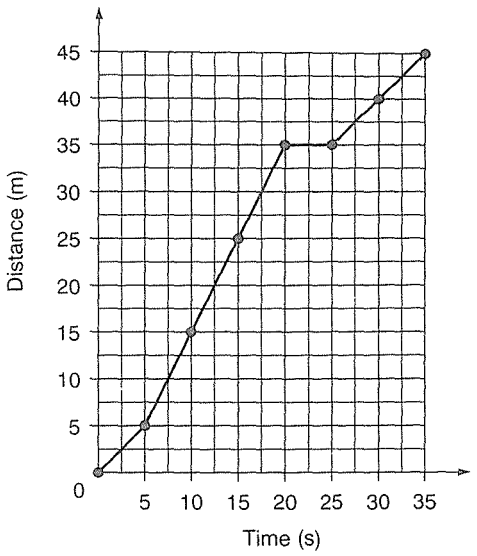
3. Average speed $v_{av} = s/t$
   (a) a car = 500 m/30 s = 16.7 ms^{-1}
   (b) a jogger = 100 m/50 s = 2 ms^{-1}

4. A car starting from rest is travelling at 30 ms^{-1} after 90 s. Calculate the car's acceleration.
   $a = \frac{v - u}{t} = \frac{(30 - 0)\text{ ms}^{-1}}{90\text{ s}} = 0.33\text{ ms}^{-2}$

5. (a) constant velocity throughout
   (b) constant slow velocity then instantaneous acceleration to constant faster velocity
   (c) deceleration from constant fast speed to constant slower speed

6. (a) 0–10 s: 20 m/10 s = 2 ms^{-1}
   (b) 10–20 s: stationary, zero gradient
   (c) 20–30 s: 5 m/10 s = 0.5 ms^{-1}
   (d) 30–35 s: 10 m/5 s = 2 ms^{-1}
   (e) 35–45 s: 10 m/10 s = 1 ms^{-1}

7. (a)



(b) Maximum speed is between 5 and 20 s.
(c) Maximum speed is 30 m/15 s = 2 ms^{-1}.
(d) The object was at rest between 20 and 25 s.

8. The distance–time graph for each of the following:
(a) an accelerating object is curved upwards
(b) an object moving at constant speed is a straight line that is not parallel to the time axis
(c) a stationary object is a straight line parallel to the time axis.

9. Speed–time graph for
(a) 0–10 s: constant speed of 2 ms^{-1}, straight line parallel to the time axis
(b) 10–20 s: stationary, graph lies along the time axis because speed is zero
(c) 20–30 s: constant speed of 0.5 ms^{-1}, straight line parallel to the time axis.

10. (a) The acceleration during:
(i) 0–10 s = zero, no gradient
(ii) 10–15 s = (25 – 5) ms^{-1}/5 s
= 4 ms^{-2}
(iii) 15–20 s = zero, no gradient
(iv) 20–25 s = (0 – 25) ms^{-1}/5 s
= – 5 ms^{-2}, or a deceleration of 5 ms^{-2}

(b) Total distance is the area under the speed–time graph: $(5 \times 15) + [\frac{1}{2}(20 \times 5) + (25 \times 5) + \frac{1}{2}(25 \times 5)]$
= 75 + [50 + 125 + 62.5]
= 312.5 m
Total distance is 312.5 metres.

(c) Any reasonable, correct answer should be accepted. The object moves at a constant speed of 5 ms^{-1} for the first 10 s. During the next 5 s the object accelerates until at 15 s it is moving at 25 ms^{-1}. Between 15 and 20 s the object moves at the constant speed of 25 ms^{-1}. For the time between 20 and 25 s the object slows down uniformly until it stops.

BLM 21: Energy and falling

1. $v^2 = 2gh$
Here h = 15 m and g = 10 ms^{-2}, so
$v^2 = 2 \times 10\ ms^{-2} \times 15$ m
$= 300\ m^2s^{-2}$
so $v = 17.3\ ms^{-1}$
The roller coaster was moving at 17.3 ms^{-1}.

2. $v^2 = 2gh$
Here h = 5 m and g = 10 ms^{-2}, so
$v^2 = 2 \times 10\ ms^{-2} \times 5$ m
$= 100\ m^2s^{-2}$
so $v = 10\ ms^{-1}$
The roller coaster was moving at 10 ms^{-1}.

3. $v^2 = 2gh$
Here v = 15 ms^{-1} and g = 10 ms^{-2},
so $225\ m^2s^{-2} = 2 \times 10\ ms^{-2} \times h$
so $225\ m^2s^{-2} = 20\ ms^{-2} \times h$
$h = 225\ m^2s^{-2}/20\ ms^{-2}$
h = 11.25 m
The roller coaster had fallen 11.25 m.

4. $v^2 = 2gh$
Here v = 10 ms^{-1} and g = 10 ms^{-2},
so $100\ m^2s^{-2} = 2 \times 10\ ms^{-2} \times h$
so $100\ m^2s^{-2} = 20\ ms^{-2} \times h$
h = 5 m
The Ferris wheel had fallen 5 m.

5. $v^2 = 2gh$
Here v = 20 ms^{-1} and g = 10 ms^{-2},
so $400\ m^2s^{-2} = 2 \times 10\ ms^{-2} \times h$
so $400\ m^2s^{-2} = 20\ ms^{-2} \times h$
$h = 400\ m^2s^{-2}/20\ ms^{-2}$
h = 20 m
The cliff was 20 m high.

6. $v^2 = 2gh$
Here h = 50 m and g = 10 ms^{-2}, so
$v^2 = 2 \times 10\ ms^{-2} \times 50$ m
$= 1000\ m^2s^{-2}$
so $v = 31.6\ ms^{-1}$
The drop was theoretically falling at 31.6 ms^{-1} when it rejoined the river at the end of its fall. (It may have reached a terminal velocity lower than this during its fall.)

Something to think about:
Potential energy is converted into heat and sound energy as well as kinetic energy.

BLM 23: Another look at the first twenty elements

1.

Atomic number	*Element*	*Symbol in equation*	*Number of protons*	*Electron arrangement*	*Mass number*	*Number of neutrons*
1	hydrogen	$H_{2(g)}$	1	1	1	0
2	helium	$He_{(g)}$	2	2	4	2
3	lithium	$Li_{(s)}$	3	2, 1	7	4
4	beryllium	$Be_{(s)}$	4	2, 2	9	5
5	boron	$B_{(s)}$	5	2, 3	11	6
6	carbon	$C_{(s)}$	6	2, 4	12	6
7	nitrogen	$N_{2(g)}$	7	2, 5	14	7
8	oxygen	$O_{2(g)}$	8	2, 6	16	8
9	fluorine	$F_{2(g)}$	9	2, 7	19	10
10	neon	$Ne_{(g)}$	10	2, 8	20	10
11	sodium	$Na_{(s)}$	11	2, 8, 1	23	12
12	magnesium	$Mg_{(s)}$	12	2, 8, 2	24	12
13	aluminium	$Al_{(s)}$	13	2, 8, 3	27	14
14	silicon	$Si_{(s)}$	14	2, 8, 4	28	14
15	phosphorus	$P_{(s)}$	15	2, 8, 5	31	16
16	sulfur	$S_{(s)}$	16	2, 8, 6	32	16
17	chlorine	$Cl_{2(g)}$	17	2, 8, 7	35	18
18	argon	$Ar_{(g)}$	18	2, 8, 8	40	22
19	potassium	$K_{(s)}$	19	2, 8, 8, 1	39	20
20	calcium	$Ca_{(s)}$	20	2, 8, 8, 2	40	20

2. Students can transfer the information from question 1 to this table.

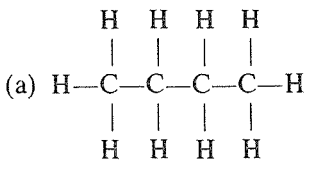
BLM 24: Carbon compounds

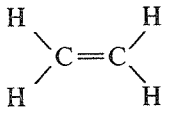
Part A

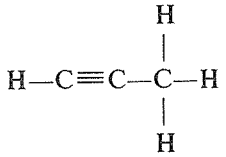
Name of alkane	*Chemical formula*	*Name of alkene*	*Chemical formula*	*Name of alkyne*	*Chemical formula*
methane	CH_4	—	—	—	—
ethane	C_2H_6	ethene	C_2H_4	ethyne	C_2H_2
propane	C_3H_8	propene	C_3H_6	propyne	C_3H_4
butane	C_4H_{10}	butene	C_4H_8	butyne	C_4H_6
pentane	C_5H_{12}	pentene	C_5H_{10}	pentyne	C_5H_8
hexane	C_6H_{14}	hexene	C_6H_{12}	hexyne	C_6H_{10}
heptane	C_7H_{16}	heptene	C_7H_{14}	heptyne	C_7H_{12}
octane	C_8H_{18}	octene	C_8H_{16}	octyne	C_8H_{14}
nonane	C_9H_{20}	nonene	C_9H_{18}	nonyne	C_9H_{16}
decane	$C_{10}H_{22}$	decene	$C_{10}H_{20}$	decyne	$C_{10}H_{18}$

Part B

1. (a) pentane
   (b) nonene
   (c) propyne
   (d) heptyne
   (e) butene

2. (a)


(b)


(c)


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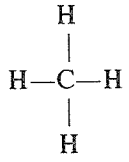
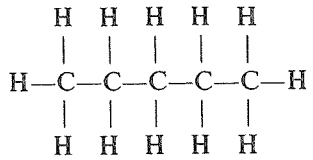


(e)


BLM 25: Bonding Earth-style

1. U probably has metallic bonding because it is shiny, malleable and conducts electricity
   V probably has ionic bonding because it has a high melting point and conducts electricity when dissolved
   W probably has metallic bonding because it is shiny and conducts electricity
   X probably has covalent bonding
   Y probably has covalent bonding because it is a non-conductive powder

2. sulfur = Y; mercury = W; salt = V; copper = U; sulfur dioxide = X

3. an active metal + acid ⟶ salt + hydrogen
   The salt would be an ionically bonded compound, with the hydrogen atoms being covalently bonded together into hydrogen molecules.

BLM 26: Chemical formulas and equations

Part A

1. $H_{2(g)}$, 2. $O_{2(g)}$, 3. $H_2O_{(l)}$, 4. $Zn_{(s)}$, 5. $ZnCl_{2(aq)}$ 6. $Mg_{(s)}$
7. $MgCl_{2(aq)}$, 8. $CaCO_{3(s)}$, 9. $CaO_{(s)}$, 10. $CO_{2(g)}$, 11. $CO_{(g)}$
12. $NH_{3(g)}$, 13. $NH_4Cl_{(s)}$, 14. $H_2SO_{4(aq)}$, 15. $(NH_4)_2SO_{4(s)}$
16. $Cu_{(s)}$, 17. $CuO_{(s)}$, 18. $HNO_{3(aq)}$, 19. $Cu(NO_3)_{2(aq)}$,
20. $NaCl_{(aq)}$, 21. $Fe_{(s)}$, 22. $FeCl_{2(aq)}$, 23. $KOH_{(aq)}$,
24. $K_2SO_{4(aq)}$, 25. $PbSO_{4(s)}$, 26. $Hg_{(l)}$, 27. $HgO_{(s)}$,
28. $HCl_{(g)}$, 29. $HCl_{(aq)}$, 30. $CuSO_{4(s)}$, 31. $BaCl_{2(s)}$,
32. $N_{2(g)}$, 33. $Br_{2(l)}$, 34. $I_{2(s)}$, 35. $Ar_{(g)}$, 36. $O_{3(g)}$
37. $Al_{(s)}$, 38. $Al_2O_{3(s)}$, 39. $Al_2(SO_4)_{3(s)}$, 40. $SO_{2(g)}$

Part B

(a) $2Mg_{(s)} + O_{2(g)} \longrightarrow 2MgO_{(s)}$
(b) $Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$
(c) $Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$
(d) $CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$
(e) $2HgO_{(s)} \longrightarrow 2Hg_{(l)} + O_{2(g)}$
(f) $NH_{3(g)} + HCl_{(g)} \longrightarrow NH_4Cl_{(s)}$
(g) $4Al_{(s)} + 3O_{2(g)} \longrightarrow 2Al_2O_{3(s)}$
(h) $S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$
(i) $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$
(j) $2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$

BLM 27: Types of substances

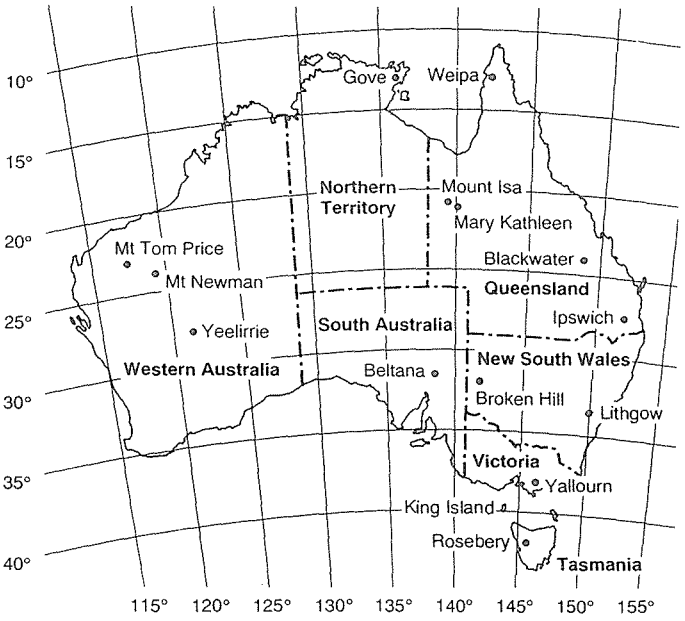
1. (a) non-metallic element
   (b) covalent network
   (c) ionic compound
   (d) metallic element
   (e) mixture
2. Look at each student's chart individually to check for accuracy.
3. (a) element (non-metallic) (b) covalent compound
   (c) mixture (d) ionic compound
4. 'Physical means' involves changes of state, sieving and so on. Only physical changes are involved.

BLM 29: Polywunder

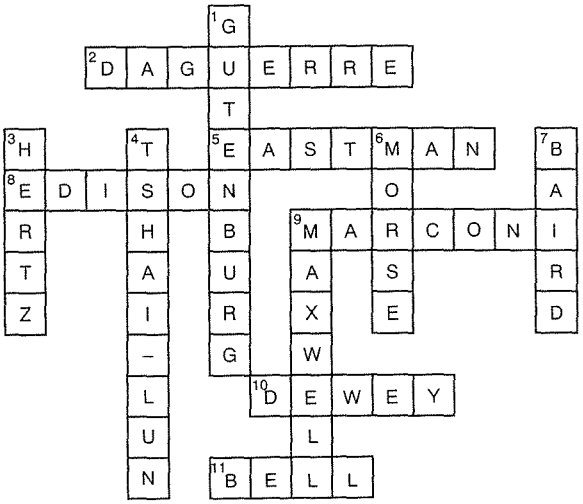
The answers to these questions should result after students have discussed the article. Some ideas for answers follow.

1. (a) The article may be accurate but it certainly approaches the idea of the throwaway society from an unusual point of view.
   (b) The case for *Polywunder* would probably be improved by inclusion of the names of places/companies that do recycle the product.
2. Emotive arguments include:
   - the description of the product as 'excitingly different' and being made from 'magnificent material'
   - 'how often have you been... and seen streaks of detergent across it?'
   - 'These detergents are harmful to you...'
3. CFC's are mentioned because they harm the ozone layer as well as contributing to the greenhouse effect.

BLM 30: Where in Australia?

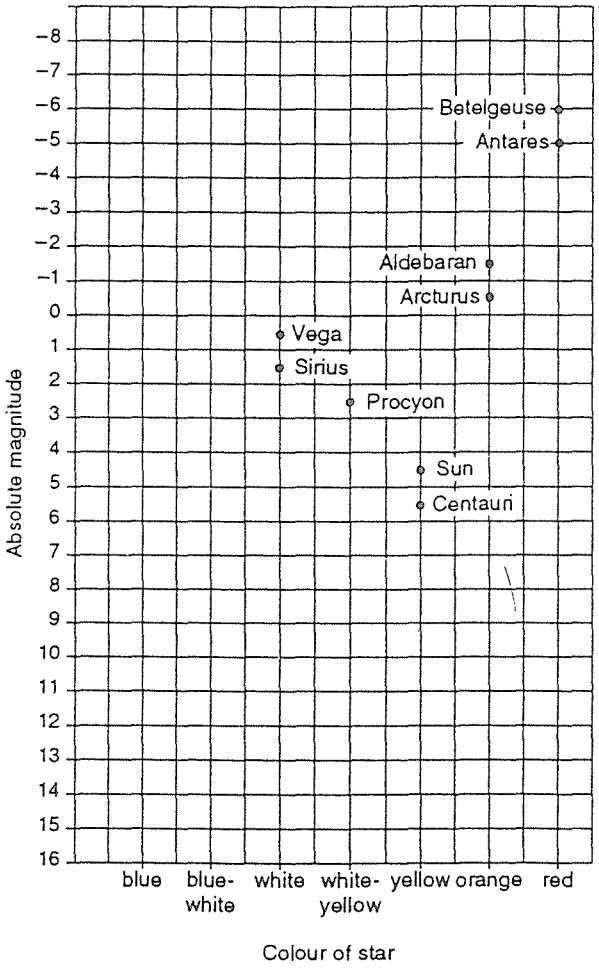


BLM 35: Crossword: People in communication



BLM 36: A different look at the stars

3. Pollux (orange) +1.16, Capella (yellow) –0.6, Spica (blue-white) –2.4, Castor (white) +1.0

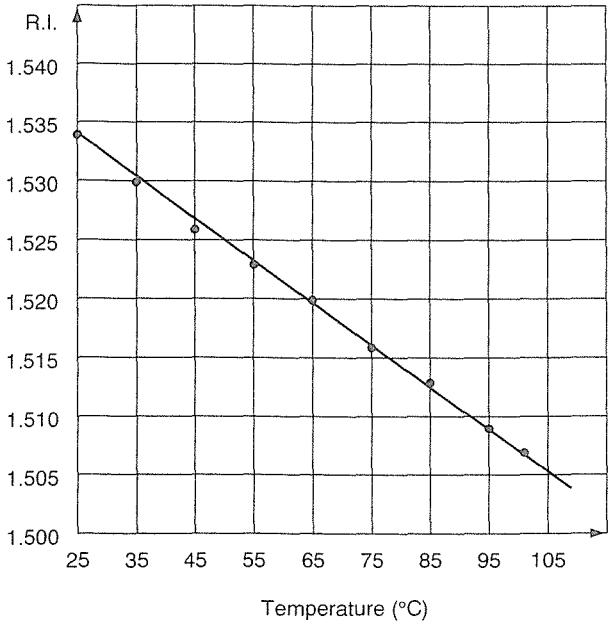


BLM 37: So you want to be a star... but which type?

1. You would become a planet because your mass is too low to become a star.
2. A massive star finishes its life as a black hole.
3. All stars with a mass greater than 0.3 solar masses become red giants during their lifetime.
4. A neutron star may result from a supernova that had less than three solar masses remaining after its explosion. (To have formed a supernova, it would have been a red giant with a mass greater than eight solar masses originally.)
5. A neutron star is commonly called a quasar (a QUAsi-stAR).
6. A nova is likely to form from a red giant having a mass between six and eight solar masses.
7. This matter may become dust in the universe until gravitational forces pull the dust together to form new stars.

BLM 40: Refractive indices of glass

1. Refractive index versus temperature



3. (a) 31°C (b) 78°C (c) 92°C (approximate values)
4. (a) 1.528 (b) 1.522 (c) 1.518 (approximate values)
5. Samples A and C are from common glass, whereas samples from C and D are more rare. Sample D may be from spectacle glass, while the rare sample B may be worth closer investigation. The source of sample B glass may provide further valuable clues.

BLM 41: How big, how small, and units too

1. A virus is 10^{-8} m long, so it could not be seen with either the human eye or a light microscope. Their maximum magnification for the human eye is 10^{-3} m and the maximum magnification for the light microscope is 10^{-6} m.

2. (a) 10^{-2} m = 1/100 m
   (b) 10^{-6} m = 1/1 000 000 m
   (c) 10^{-4} m = 1/1 000 m

3. (a) The human body is usually less than 2 m high, so the height is closer to 10^{0} m or 1 m, than 10 m.
   (b) The length of a pencil is approximately 15 cm or 0.15 m, or 1.5×10^{-1} m, which is closer to 10^{-1} m than 10^{-2} m.
   (c) The length of a classroom is closer to 10^{1} m than 10^{2} m.

4. (a) 1000 g
   (b) 1 000 000 L (1×10^{6} L)
   (c) 2 000 mm

5. (a) 36 cm = 360 mm
   (b) 30 Mt = 30 000 000 t (3×10^7 t)
   (c) 1.5 kg
   (d) 2 000 000 mg

BLM 42: Chapter 1 Topic test: Obtaining food

1. (b) 2. (c) 3. (c) 4. (d) 5. (a)

6. (a) Bacteria that may cause botulism may be present in the tin.
   (b) The food may not be safe to eat, particularly if the toxin is present. (Botulism may be fatal.)

7. Food A contained vitamin C.
   Food B contained starch.
   Food C contained glucose.

8. The farmer would need to have tests done to see if geep cells contained genetic information from both a goat and a sheep.

9. The Industrial Revolution meant that all aspects of farming were changed. Machinery meant that more land could be farmed by fewer people. Wider areas of farmland meant greater food production.
10. (a) Any form of asexual reproduction (in plants) used in the text would be acceptable.
    (b) The parent and offspring are identical when reproduction occurs asexually.
11. Let the yellow flower be YY and the red flower be RR, so the orange flower will be YR.

	Y	R
Y	YY	YR
R	YR	RR

From the Punnett square, 25% of the flowers will be red, 25% will be yellow and 50% will be orange.

12. A wide variety of answers are acceptable. One possible example is included here for your reference. *Note:* Any sensible results should be accepted.

Aim: To determine whether thick white bread or crumpets stay fresher longer.

Method:
1. A slice of thick white bread and a crumpet, that had been baked on the same day, were obtained.
2. The samples were placed in the same cool dry place.
3. Observations of the bread and crumpet were made daily.

Possible results:

Day number	*Observations*	
	White bread slice	*Crumpet*
1	No change	No change
2	Bread appeared to be drying out	Crumpet seemed to be getting hard around the edges
5	Bread seemed drier	Crumpet has tiny amount of mould in the middle
7	Bread has a small amount of mould	Crumpet is all mouldy

Conclusion:
The white bread in the experiment stayed fresher longer.

Controls:
- day of baking/freshness at the beginning
- same environment
- when the observations were made (each at the same time)

Variables: the bread and crumpet

BLM 43: Chapter 2 Topic test: Staying healthy

1. (b) 2. (a) 3. (c) 4. (d) 5. (b)

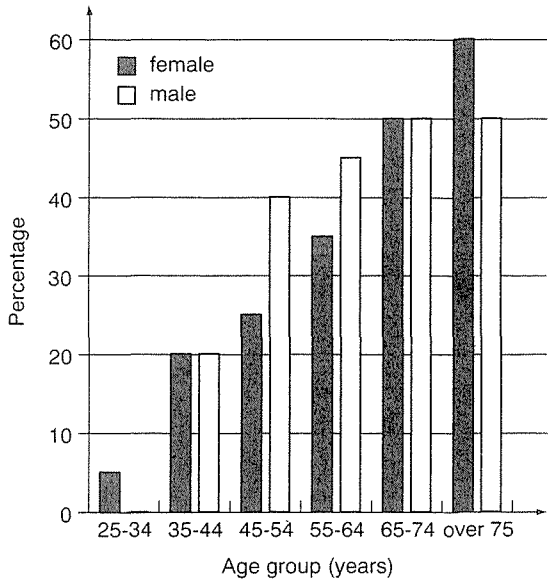
6. (a) (i) Milk low in fat should reduce fat intake.
   (ii) Milk high in calcium is recommended for women to ensure that bones stay strong and healthy.
   (b) rickets, soft bones, poor teeth (two examples only requested)

7. (a) alcohol, cigarettes (Any other drug would be appropriate provided students gave a correct negative effect in part (b))
   (b) Alcohol causes reduction in brain functioning, and can cause permanent brain damage.
   Cigarette smoking is linked with lung cancer, emphysema and so on.

8. (a) High stress levels, poor eating and drinking habits, and inadequate exercise may cause problems for some business people.
   (b) These people (in fact, all people) need to ensure that good diet, exercise and relaxation form part of their lifestyle.

9. (a) Air and water pollution, together with inadequate sanitation, may cause problems.
   (b) Respiratory problems may be linked to air pollution, while diseases such as typhoid are linked to problems with water and sanitation.

10. (a) Approximate percentage of deaths due to cardiovascular disease versus age group



(b) (i) Women are most at risk when they are over 75 years of age.
(ii) Men are most at risk when they are 65 years of age or more.
(c) High levels of stress, lack of exercise, poor diet, cigarette smoking and alcohol, are believed to increase the risk of cardiovascular disease.

11. This is a difficult question and any reasonable answers should be accepted.

Groups of children would need to be studied. The behaviour of a group that ate sweets and chocolate would need to be compared to a group who did not eat sweets.

It would be difficult to set up controls, but children whose behaviour and general ability were usually similar, should be chosen.

Both groups of children could be set a task that requires concentration, and their success assessed.

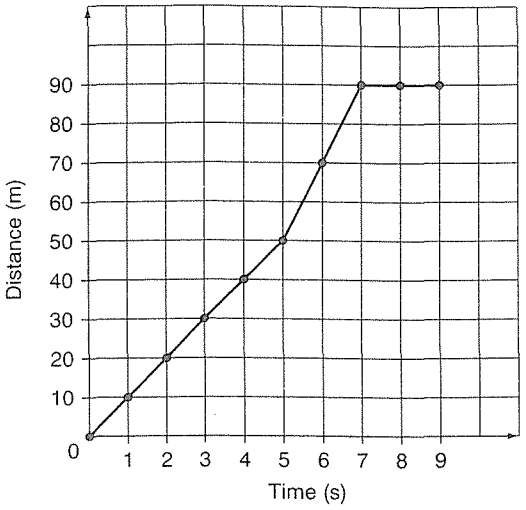
Another useful control would be to set the groups of children a similar task at a different time of day, to ensure that students could actually perform the task equally well at another time of day.

It may be useful to test other children whose diet had not been monitored.

Results may show no differences between children, and thus the hypothesis relating food and concentration would not be valid. If there were marked differences in results, then diet may have something to do with concentration and further testing may be advisable.

BLM 44: Chapter 3 Topic test: Motion

1. (d) 2. (d) 3. (d) 4. (b) 5. (a)
6. Children are held in contact with the seat of the horse on the merry-go-round, forcing the rest of the body to move in a circle. This inward pull on the lower half of the body is felt as an outward sensation by the top half of the body.
7. Newton's first law states that a body in motion will continue to move with the same velocity unless it is acted on by an external force. The space craft was moving when the fuel ran out, so it will continue to move in the same direction at the same speed until it collides with something or is affected by the gravity of a celestial body.
8. Male swimmers shave their heads to cut down the friction in the water.
9. (a) Distance versus time graph



(b) Average speed for first 5 s: 50 m/5 s = 10 ms^{-1}.
(c) The train travelled at a constant velocity of 10 ms^{-1} for the first 5 s. It then moved at 20 ms^{-1} for 2 s. At 7 s it stopped, and it remained stationary until 9 s.

10. As for all experimental design questions, all reasonable answers should be accepted. Class discussion will help students develop skills related to design. In this design, the distance the ball travels is the main concern.
(a) The ball should be tested to see how it compares with other popular balls. It would be best to get the same golfer to test each of the balls, under exactly the same conditions (place, time, weather conditions, surface, type of club used and so on) to ensure that valid comparisons could be made.

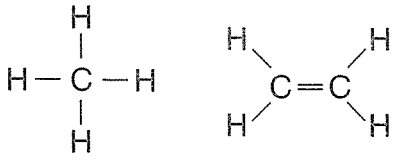
(*Note:* Reproducing exactly the same stroke with exactly the same force will be difficult. If a mechanical device capable of hitting a ball with the same force, angle and so on was available, this would be preferable.)

(b) All the variables listed will need to be controlled, as well as the angle at which the ball is hit. Forces include the stroke, wind, type of surface on club, whether there is a bounce and the surface on which it bounces. The only things that should vary in the experiment are the ball and the distance that each ball travels.

BLM 45: Chapter 4 Topic test: Holding matter together

1. (c) 2. (c) 3. (d) 4. (b) 5. (a)

6. 17 protons, 17 electrons and 20 neutrons
7. (a) CH_4 (b) C_2H_4



Note: You may prefer students to draw methane with its bonds arranged tetrahedrally.

8. (a) To produce water, any acid reacted with potassium hydroxide will do, for example
aqueous potassium hydroxide + hydrochloric acid ⟶ potassium chloride + water
To produce magnesium chloride
solid magnesium + hydrochloric acid ⟶ aqueous magnesium chloride + hydrogen gas

Note: This reaction also produces hydrogen. However, the question asked for three equations, so another is needed.

To produce hydrogen gas
solid zinc + hydrochloric acid ⟶ aqueous zinc chloride + hydrogen gas

(b) $KOH_{(aq)} + HCl_{(aq)} \longrightarrow KCl_{(aq)} + H_2O_{(l)}$
$Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$
$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$

9. (a) $KMnO_4$ (b) $(NH_4)_3PO_4$ (c) Li_2SO_4 (d) $SnCl_4$ (e) $AlPO_4$ (f) CS_2 (g) NH_3 (h) BaI_2

10. Students will hopefully choose to carry out titrations to compare the acidities.

Titrate a known volume of hydrochloric acid (and indicator) with a suitable hydroxide. Record the volume of hydroxide required to neutralise the acid.

Repeat the titration using lemon juice instead of hydrochloric acid. Compare the volumes of hydroxide required to reach the endpoints for hydrochloric acid and lemon juice.

Possible results: The volume of hydroxide required to neutralise three lemon juice solutions may be 12.5 mL, 12.6 mL, 12.7 mL giving an average of 12.6 mL; while the volumes for the hydrochloric acid may be 20.1 mL, 20.3 mL and 20.5 mL, giving an average of 20.3 mL. Thus the hydrochloric acid would be stronger because it took more alkali to neutralise this acid.

Note: For the purposes of this exercise, volumes have only been taken to one decimal place, and it has been assumed that students would realise that dilute hydrochloric acid will be a stronger acid and require more alkali for neutralisation.

BLM 46: Chapter 5 Topic test: Geology in Australia

1. (c) 2. (a) 3. (d) 4. (c) 5. (b)

6. (a) Kunwarara, Qld
(b) Any opal mining centre, for example Lightning Ridge, N.S.W. and Mintabie, S.A.

7. Platinum is the least reactive metal, so would not react with substances, such as body fluids, detergents and so on, making it a good metal for jewellery.

8. (a) talc (b) mica (c) iron(III) ferrocyanide
(d) chromium hydroxide or chromium oxides

9. (a) (i) sintering (ii) flotation (iii) after shipping and recovery (iv) milling
(b) No, it hasn't undergone any purification processes at this stage. (*Note:* Zinc is usually electrolysed to obtain pure form.)

10. The Argyle mine is the world's biggest diamond-producing mine.
11. (a) industrial diamonds (55%)
(b) gem quality diamonds (5%)

12. Use the hardness kit to decide if the material is glass or diamond. If the substance is diamond, it will scratch every mineral with a hardness up to 9 in the kit. If the substance is scratched by minerals having a hardness greater than 5.5, then the substance may be cut glass.

(*Note:* Material could be added to this question to make the allocation of 10 marks easier, if required.)

BLM 47: Chapter 6 Option 1 Topic test: Communication

1. (b) 2. (a) 3. (c) 4. (d) 5. (b)
6. (a) radio (b) telegraph
7. Discs need an appropriate machine to read their data, and the discs may be damaged by heat and magnetic fields.
8. The Dewey system classifies the non-fiction section of a library using a series of numbers that correspond to subject areas. For example, books related to natural sciences occur in the 500s and books related to history are in the 900s.
9. This devised system may simply have a continual plume of smoke to warn of danger. Short puffs of smoke may indicate that the danger has passed. Short and long puffs of smoke alternating may mean that a meeting is needed, and so on. (The puffs of smoke could be arranged by holding objects over the fire for set periods to stop the smoke.)

BLM 48: Chapter 6 Option 2 Topic test: The universe

1. (b) 2. (c) 3. (d) 4. (b) 5. (b)
6. The two main theories of the origin of the universe are the big bang theory and the steady state theory. The big bang theory suggests that all matter arose from a tiny area at a particular instant in time. At this time there was a huge explosion and all matter moved away from the initial area. Evidence suggests that the universe continues to expand.

The steady state theory suggests that the universe has always existed and that it is constantly expanding. According to this theory, new material is constantly forming as the universe expands. This formation of new material would result in the overall appearance of the universe remaining the same.

7. Space travel is likely to become more important to relieve overcrowding on Earth. (Another possible reason for space travel would occur if the Earth were ever to be on a collision course with a large celestial object.)
8. (a) N-P 11 has a tilted axis, so is likely to experience seasons.
   (b) Earth should have a warmer climate because it is much closer to its sun.
   (c) The night sky on N-P 11 will have up to three moons visible at any one time. (These moons may be showing different phases depending upon their relative position to their planet and sun.)

BLM 49: Chapter 6 Option 3 Topic test: Forensic science

1. (c) 2. (d) 3. (d) 4. (b) 5. (c)
6. (a) The observations are that the window is broken and there is a cricket ball nearby.
   (b) You may infer that the cricket ball broke the window.
7. Dinosaur footprints are more common than dinosaurs. One dinosaur would have made many footprints in its lifetime, thus it should be easier to find prints than bones.
8. People may obtain or guess a PIN number to wrongfully obtain someone else's money. However, assuming that the patterns in irises are indeed unique, then it would not be possible to gain access to someone else's account.
9. There is no way of knowing for certain whether Napoleon was poisoned or not. The existence of arsenic-containing compounds in the environment means that his body may have obtained the poison from his surroundings.
10. (a) Any three of: fingerprints, tyre tracks, footprints, bloodstains, hairs and so on.
    (b) One only method required with a brief explanation. Dusting of fingerprints, using any acceptable method; taking plaster casts of footprints or tyre tracks; or carrying out DNA fingerprinting on any suitable materials.